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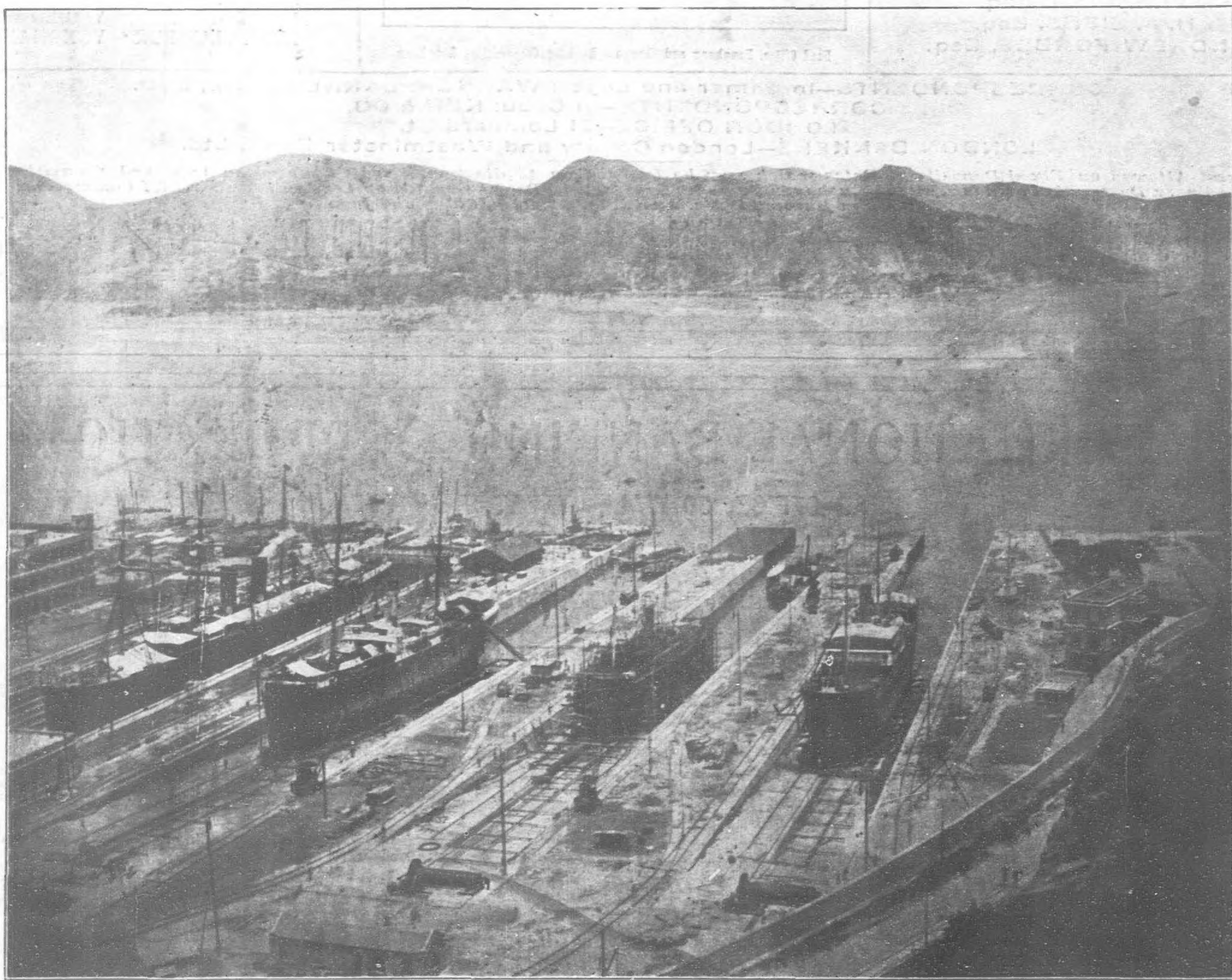
# THE FAR EASTERN REVIEW

VOL. VII.—No. 11.

MANILA, SHANGHAI AND YOKOHAMA, APRIL, 1911.

50 Centavos Philippine Currency  
25 Cents. U. S. C.

## SHIPBUILDING AND ENGINEERING WORKS OF THE FAR EAST



General View of the Extensive Dockyards and Slipways of the Taikoo Dock & Engineering Company of Hongkong

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ENGINEERING  
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# Hongkong and Shanghai Banking Corporation

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# THE FAR EASTERN REVIEW

COMMERCE • ENGINEERING • FINANCE

VOL. VI.

MANILA, P. I., SHANGHAI, AND YOKOHAMA, APRIL, 1911

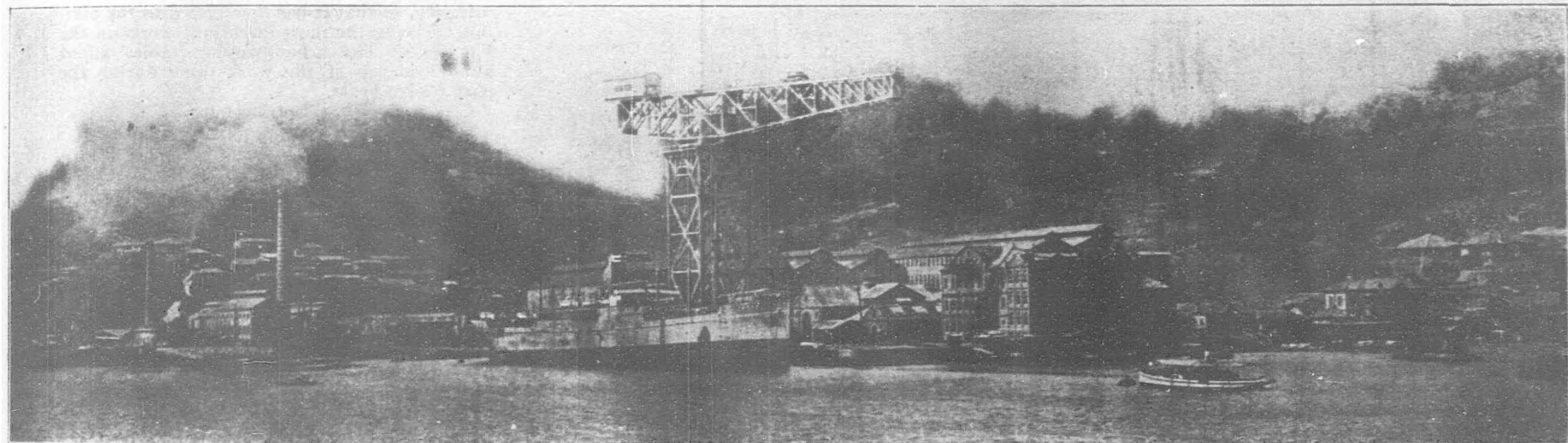
No. II.

## THE MITSU BISHI DOCKYARD AND ENGINE WORKS AT NAGASAKI

The Mitsu-Bishi Dockyard and Engine Works at Nagasaki is one of the oldest and largest shipbuilding and engineering establishments in Japan, if not in the East. It is not only one of the largest, but it is equipped with the greatest variety of tools for the production without sub-contracting of every type of ship, machinery and boilers for land and marine use, steel girders and buildings, also electrical machinery. Its specialties are Parsons' Marine Steam Turbines and Turbo-Generators, Stone's

engineers were employed, and the necessary machines and gear for commencing the works were imported from Holland. A portion of the jetty where the 150 ton giant crane now stands was constructed then by means of an old-fashioned diving bell of Dutch make, which apparatus still remains in the works in memory of the founders. Work was then carried on only on a very small scale for the purpose of repairing small steamers owned by the "Shogun." At the restoration the Works came

under the control of the Public Works Department and were very much extended. In 1871 a large dry dock at Tategami, now called No. 1 Dock, was constructed, the patent slip at Kosuge, then owned by a British merchant, was purchased, and from time to time the works were considerably developed. In 1883 a wooden steamer named the *Kosuge Maru* of 1,500 tons gross was built, which was the forerunner of the shipbuilding industry in this Island Empire.



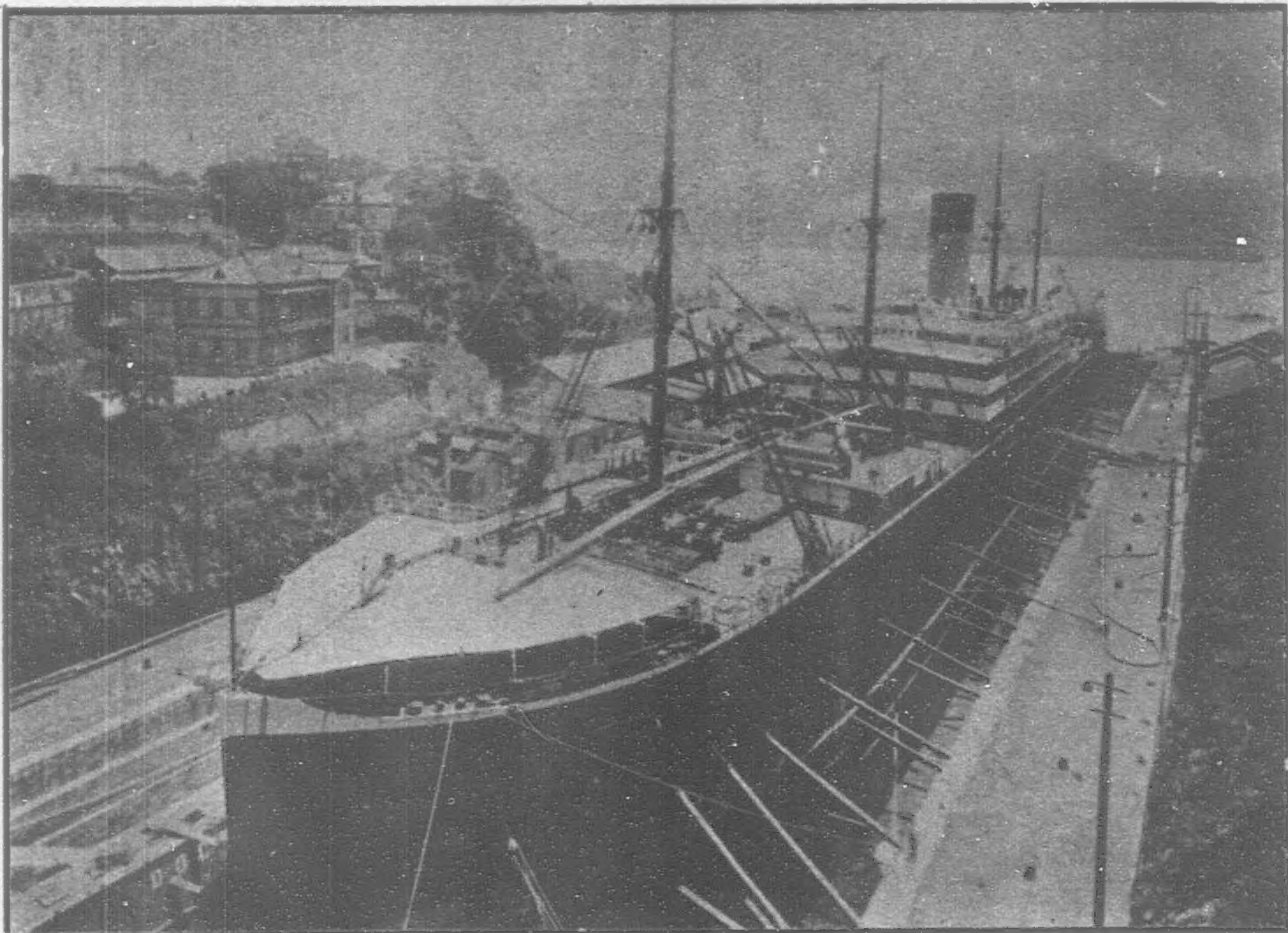
GENERAL VIEW, MITSU BISHI DOCKYARD AND ENGINE WORKS, NAGASAKI, JAPAN

### Manganese Bronze Casting and Morison's Contraflo Condenser

Many shipbuilding firms are content to construct the more important items of a ship, depending to a great extent upon other establishments for the manufacture of auxiliary parts. The principal advantage of this practice is that there is less capital involved in plant, consequently less loss incurred during the periods of depression which regularly recur.

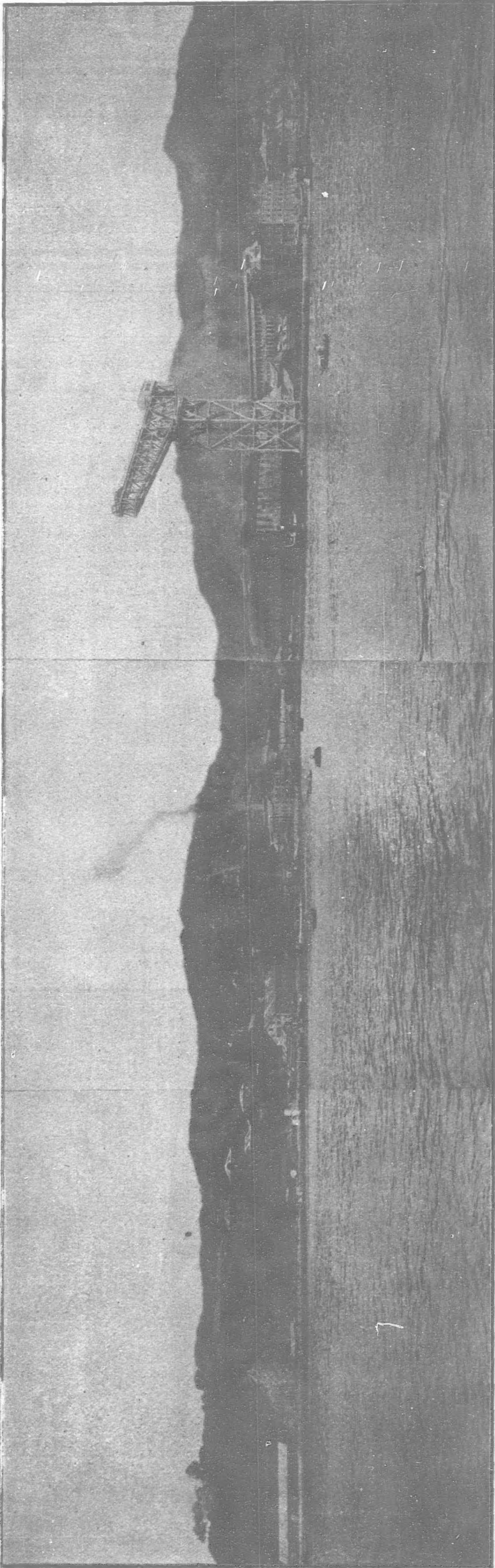
**Maximum Amount of Work.**—The Mitsu-Bishi Works on the other hand, like those at Barrow or Clydebank in Great Britain, are laid out with the object of doing the maximum amount of work upon any ship, purchasing from outside sources only raw materials and proprietary or patented articles. The advantage of this method is that there is not only economy in production under one management, but less likelihood of the separate items being delivered behind time, and so interfering with the consecutive progress of the building of the ships. Moreover, there is no better plan for the Mitsu-Bishi Works to adopt than this, for, although Japanese manufactures are rapidly improving, those of shipbuilding and engineering accessories are yet in their infancy, and cannot be depended upon for the best class of work and material, which the Mitsu-Bishi Co. is ever anxious to turn out from their works.

**History of the Works.**—The works have a very interesting history, being founded by the "Shogun" Government in 1856. Dutch en-



S. S. MINNESOTA IN NO. 3 DOCK





GENERAL VIEW OF THE AKUNOURA ENGINE WORKS OF THE MITSU BISHI CO. AT NAGASAKI

*First Iron Steamer Built.*—In 1884, on the abolition of the Department of Public Works, the establishment and the various subsidiary works connected with it were purchased by the Mitsu-Bishi Company, who started this branch of business with only 800 men. Three years later the first iron steamer of about 206 tons gross, named the *Yugao Maru*, was built, followed by three other steel steamers, the *Chikugogawa Maru*, the *Kisogawa Maru* and the *Shinanogawa Maru*, each about 700 tons gross, and also by the steel steamer *Suma Maru*, 1592 tons gross, built in 1895, which was then considered an epoch in the shipbuilding industry of Japan. But the true development dates from the termination of the Chino-Japanese War. In 1896 a great stimulus was given to the growth of shipping and shipbuilding in Japan by the enactment of the Navigation Encouragement Law and the Shipbuilding Encouragement Law. About this time the Nippon Yusen Kaisha first organized its European Line, and decided to build six steamers of 6,000 tons each. The construction of one of these steamers was undertaken by the works and was finished in 1898. This was the first steamer of such dimensions ever built in Japan, and subsequently there were built many vessels including the Turbine Trans-Pacific liners of 13,500 tons, destroyers, despatch boats, etc. During this period the Mitsu-Bishi Company continued to keep the works constantly supplied with the latest and most improved tools, appliances and plant. Leading members of the staff were despatched to the various European engineering centres to learn the most up-to-date method of construction, and a number of British experts were engaged as technical advisers and instructors. Immediate returns were looked upon as a very secondary consideration, the whole aim of the firm being to equip an establishment of which Japan might be proud in respect to both workmanship and business integrity, so that it has now grown to the position of being the most important works in the Far East. The accompanying tables afford some evidence of the work done during the past twelve years.

TABLE I.

*Annual Production of the Works during the past Twelve Years.*

Year.	No. of Vessels.	En- gines.	Gross Tons.	I. H. P.	Average Workmen employed per day.
1898.....	4	4	7,703	4,225	3,430
1899.....	12	12	4,007	3,189	3,558
1900.....	13	9	11,617	13,519	3,792
1901.....	6	6	7,194	6,238	5,209
1902.....	9	6	15,807	13,336	5,193
1903.....	8	8	13,078	11,463	5,658
1904.....	7	5	11,859	12,082	5,292
1905.....	9	7	12,973	12,731	6,745
1906.....	13	11	10,031	22,735	8,871
1907.....	4	4	7,859	23,519	9,669
1908.....	4	4	23,332	36,417	9,011
1909.....	4	4	29,596	33,379	5,703

TABLE II.

*Numbers and Gross Tonnage of Vessels docked during the Past Twelve Years.*

Year.	Dry Docks.		Slip.	
	No. of Vessels.	Gross Tonnage.	No. of Vessels.	Gross Tonnage.
1898.....	84	254,069	19	3,539
1899.....	95	272,146	29	9,042
1900.....	103	260,269	32	9,271
1901.....	111	283,977	30	10,013
1902.....	76	177,418	31	10,121
1903.....	47	133,840	20	5,295
1904.....	65	155,279	26	6,271
1905.....	117	352,758	22	7,776
1906.....	97	385,834	26	8,167
1907.....	90	243,808	17	3,928
1908.....	39	135,606	17	3,672
1909.....	57	148,102	13	1,657

*General Arrangement of the Works.*—The establishment, which is situated on the inner harbour of Nagasaki, extends along almost the whole of the Western Shore of the harbor, having a water frontage of about 8,000 ft., and covering an area of over 114 acres, with numerous workshops and dry docks equipped with all the latest and most up-to-date machine tools and appliances for shipbuilding, engineering, dry-docking and electrical engineering work, besides a powerful hydraulic and electrical installation, and pneumatic plants for the lighter class of work, such as rivetting, caulking, chipping, etc.

The works consist of four principal sections, viz: Shipbuilding Yard, Engine Works, Dry Docks and Slip.

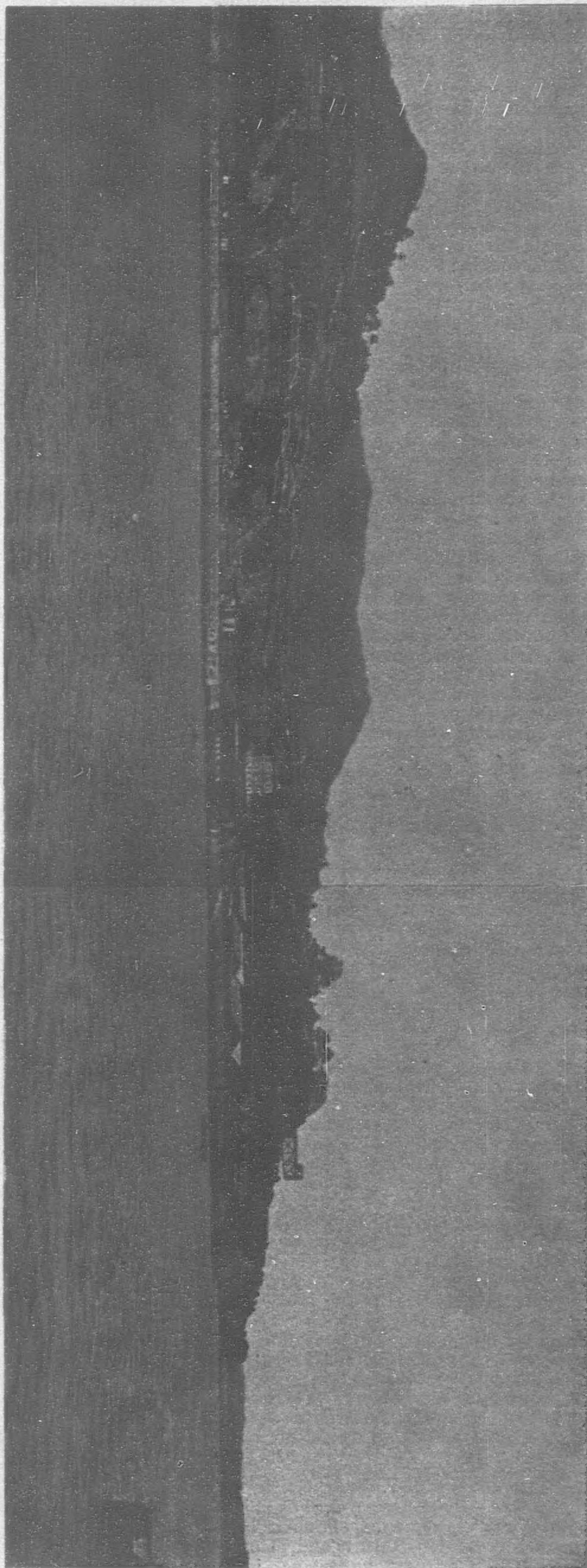
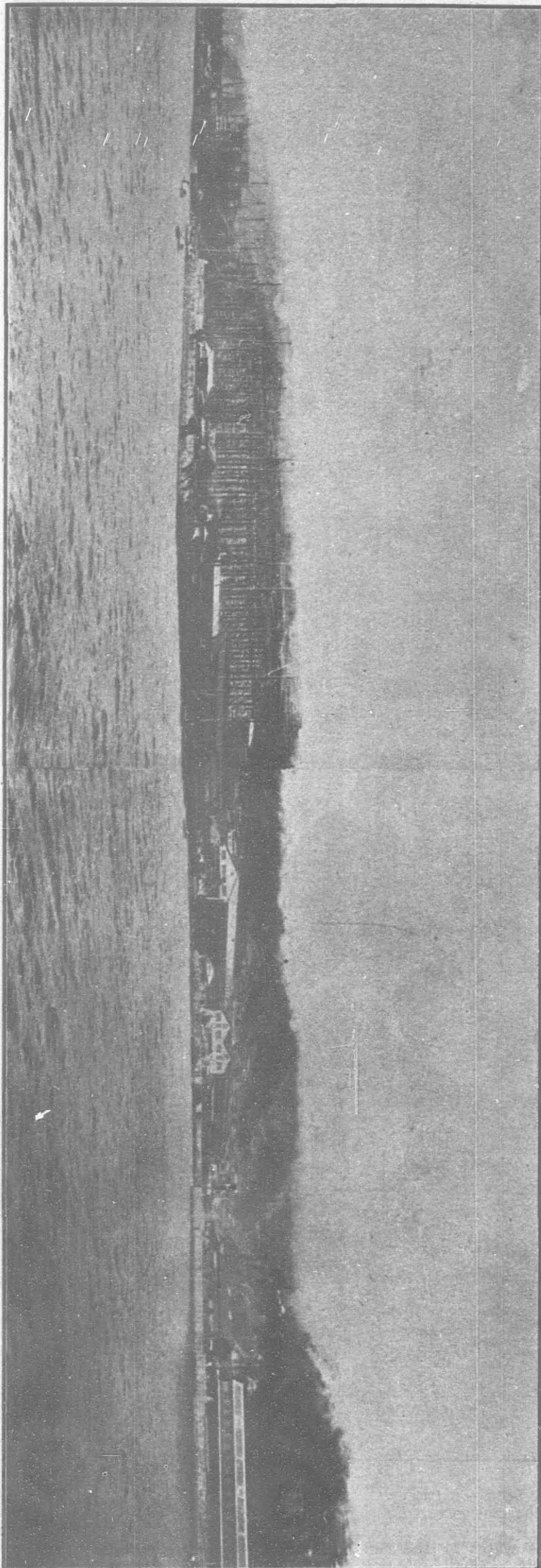


The shipyard at Tategami, which is at the south of the harbor, has seven building berths ranging from 240 ft. to 700 ft. long and an annual output capacity of over 30,000 tons.

Mould loft, scribe boards, plate and angle bending shop, plater's machine shop, smith shop galvanizing shop and machine shop are arranged at this yard. The joiners', cabinet makers',

polishing and woodworkers', upholstering and other departments associated with the ship-building are all laid out contiguous to the ship-building yard on a very extensive scale, and furnished with varied plant of the latest and most improved type.

MITSU BISHI DOCKYARD AND ENGINE WORKS: PANORAMIC VIEW OF THE YATEGANIC SHIPYARDS AND VICINITY AT NAGASAKI



The engine works at Akunoura, which is at the inner side of the harbour, covers a large area, and embraces erecting and fitting shops, boiler shop, machine shop, turbine shop, electric shop, blacksmith shop, copper smith shop, pattern and foundry shops, etc. Most of them are adequately fitted with electrically driven overhead cranes of various capacities



Between the shipyard and engine works there are three dry docks. The largest of these can accommodate vessels up to 714 ft. on the keel, 84 ft. beam and 34 ft. 6 ins. draft, and is indeed one of the finest and largest graving docks in existence at the present day. The patent slip is situated on the other side of the harbor right opposite the shipyard, and is capable of lifting ships up to 1,000 tons gross.

#### ADMINISTRATIVE DEPARTMENT.

The administrative department, or main office, is a substantial brick building in three blocks, situated at Akunoura, at the main entrance to the engine works.

The basement of the front block contains the mess room for draughtsmen and the boiler room for steam heaters. The first floor has the board room, private office of the general manager, corresponding and secretarial office, and the telephone room. The second floor is entirely occupied by the estimating engineer's office, comprising buying, estimating, counting and general statistical departments. On the floor above is situated the drawing office for Admiralty work. It is 84 ft. by 31 ft., and has accommodation for 25 ship draughtsmen and 25 engine draughtsmen. The basement of the left wing contains the main time office, book and cashier's department; the first floor the main engine drawing office, which is 69 ft. by 47 ft. with accommodation for 110 draughtsmen; and the second floor for ship drawing office, with accommodation for 42 draughtsmen. Each drawing office has a large fireproof safe at one end of the office, in which the drawings are all classified and stored. The floor above is a completely equipped photographic department with six large sun-printing frames and one Hall's Continuous Electric Copier. The basement of the right wing contains the works police department and engine works time office, while on the first floor there is a series of offices for Admiralty overseers and other superintendents.

*Drawing Offices.*—It may be mentioned here that there is a second ship drawing office at the shipyard. It is 120 ft. long by 40 ft. broad and contains the detail and the decorative departments. In the former smith work, castings and all fittings are dealt with, and in the latter all the decorative works of the ships. These two departments are specially situated in the shipyard, so as to be contiguous to the ships under construction, and to the joiners and cabinet makers, upholstery and decorative painters' workshops. The office has accommodation for 60 draughtsmen, and is equipped with photographic room and large spacious fireproof safe.

The ship drawing offices, therefore, have a staff of 127 draughtsmen in all, under the charge of the chief ship draughtsman, who has also the charge of the experimental tank.

The engine works manager has an office close by the main office, and in the same block of buildings there is the electrical engineers' drawing office, with accommodation for 15 draughtsmen.

The shipyard manager has an office at Tategami with a time office in the vicinity; there are also a number of rooms for Lloyds' surveyors, government surveyors and ship owners' superintendents in the same block of buildings.

A system of telephonic communication is in use throughout the works, so that, vast as is the establishment, its organization overcomes any disadvantages of distance. There is a regular system of storing materials, so that various sorts and dimensions are readily accessible.

#### SHIPBUILDING DEPARTMENT.

*Building Berths and Launching Ground.*—In describing the works, it may be more interesting to review the departments and plants in the order of their use and importance in the building of the ship rather than to adopt an itinerary method.

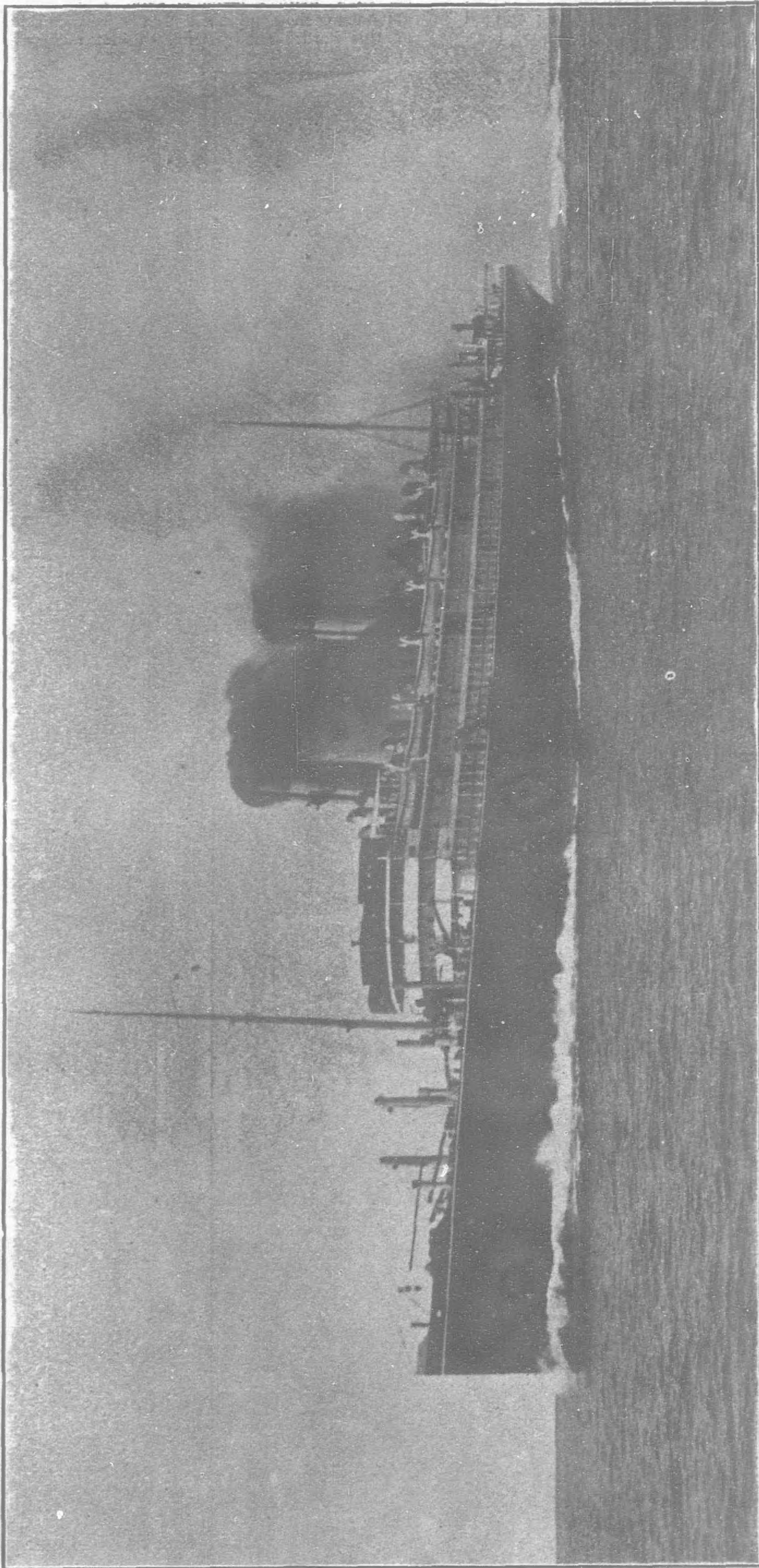
The works have seven berths, viz.:—

No. 1 Berth for vessels up to 680 ft., No. 2 Berth for vessels up to 700 ft., No. 3 Berth for vessels up to 580 ft., No. 4 Berth for vessels up to 460 ft., No. 5 Berth for vessels up to 340 ft., No. 6 Berth for vessels up to 300 ft., No. 7 Berth for two vessels up to 240 ft.

Several of these have been constructed with a view of supporting the concentrated weight of modern warships.

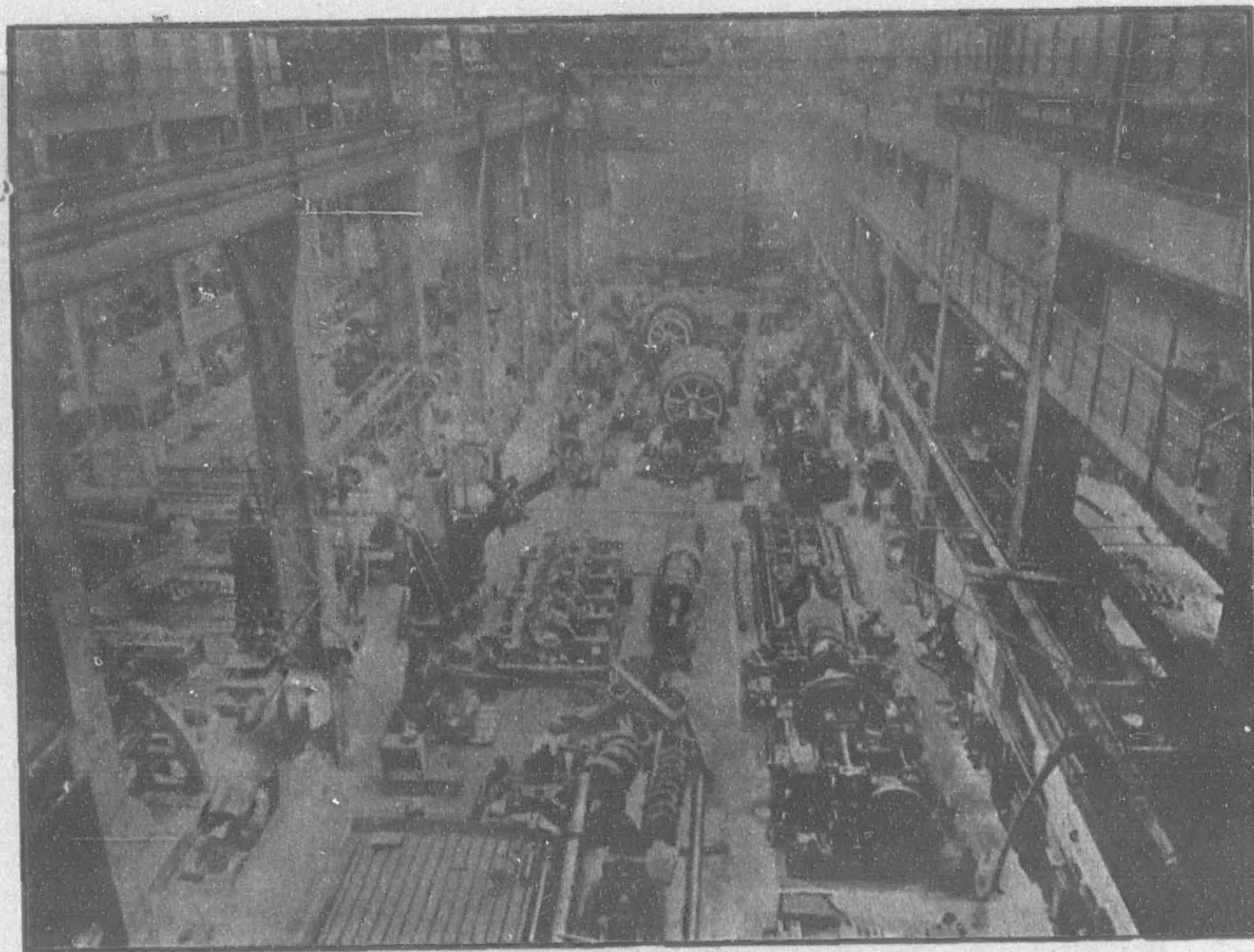
There being spacious water at the end of the building berths only a small quantity of drags and checks are required for launching the largest vessels. The berths are well equip-

ped with powerful jib cranes at frequent intervals, lifting weights up to three tons on board during construction. There are several locomotive cranes throughout the yard, ranging from five to three tons. These are also used for stocking ships' plates and angles, etc., from the lights, and for subsequently lifting

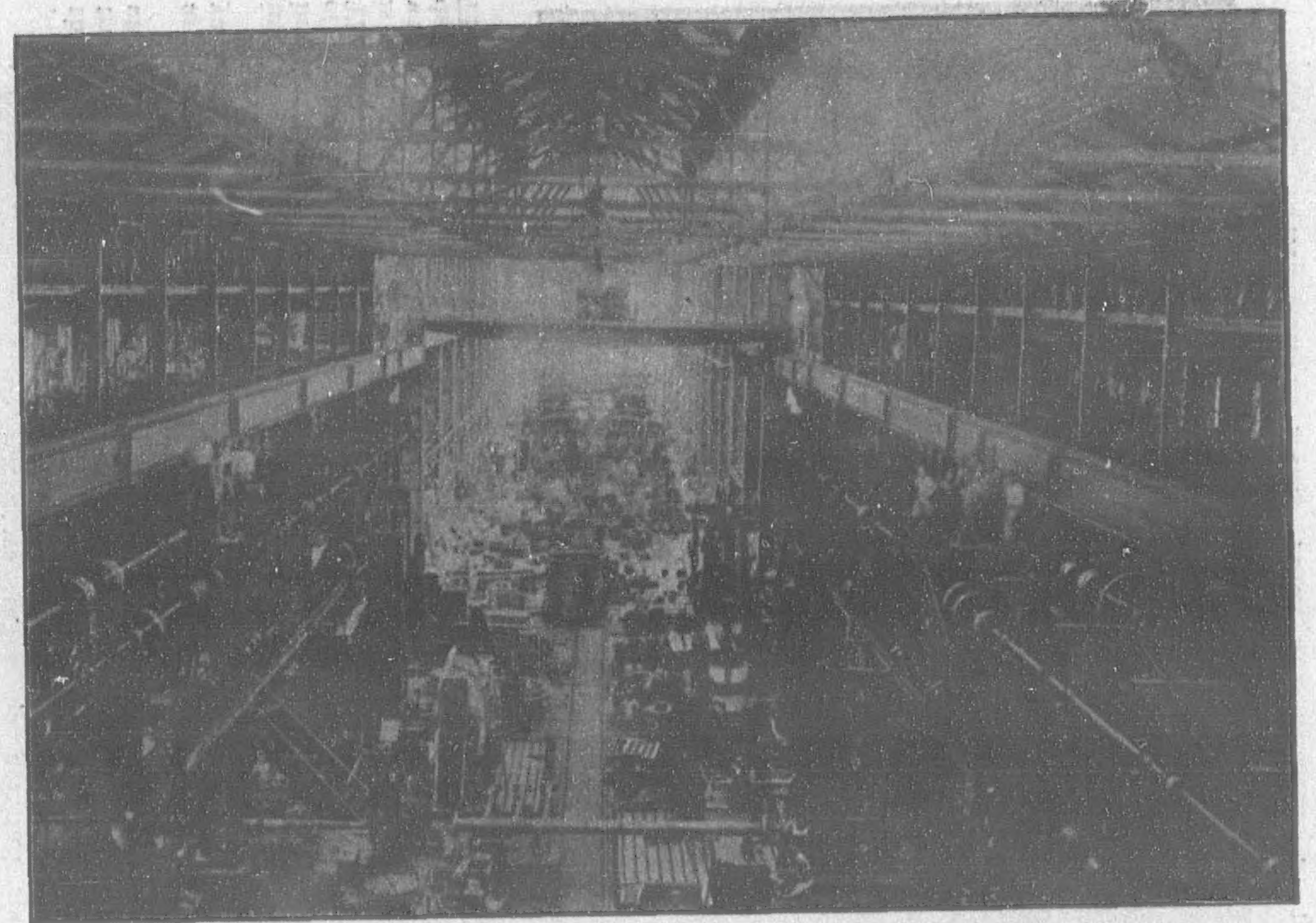


TRIPLE SCREW TURBINE STEAMER "CHIYO-MARU."—Built and engined by Mitsu Bishi Dockyard and Engine Works, Nagasaki, November 1908, to the requirements of the Imp. Japanese Government Rules and Lloyd 100 A-1.—Length, 550 feet 0"; Breadth, 63 feet 0"; Depth, 38 feet 6"; Gross tonnage, 13,500 tons; Displacement, 18,725 tons; Engines, Parsons' Three Shaft Steam Turbines; Indicated horse power, 16,850 H. P.; Speed, 21 knots; Shipowners, Messrs. Toyo Kisen Kaisha, Tokio.—(This photo was taken on her full speed trials which took place on 13th Oct. 1908.)





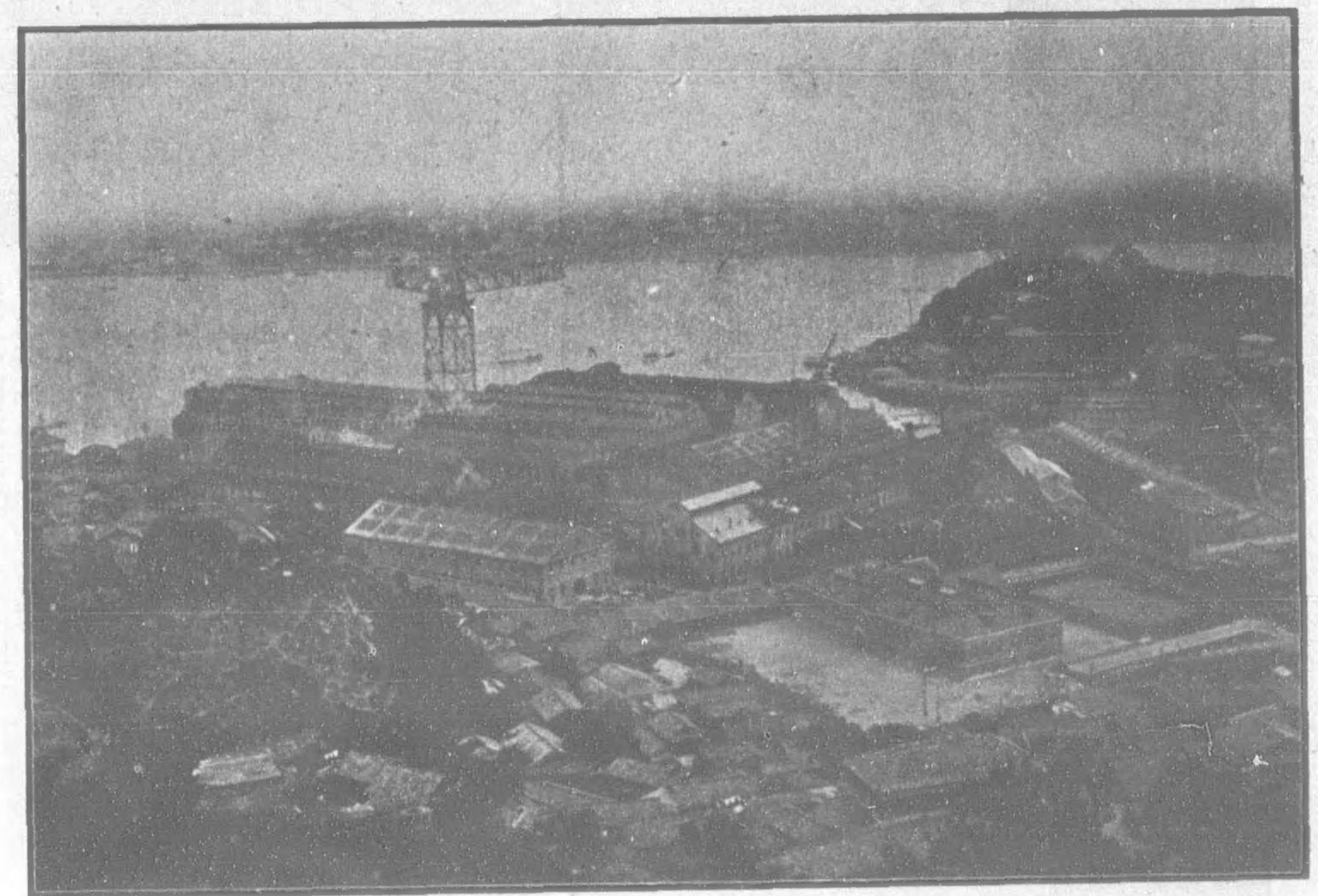
TURBINE SHOPS OF THE MITSU BISHI COMPANY AT NAGASAKI



MACHINE AND ERECTING SHOPS OF THE MITSU BISHI COMPANY AT NAGASAKI

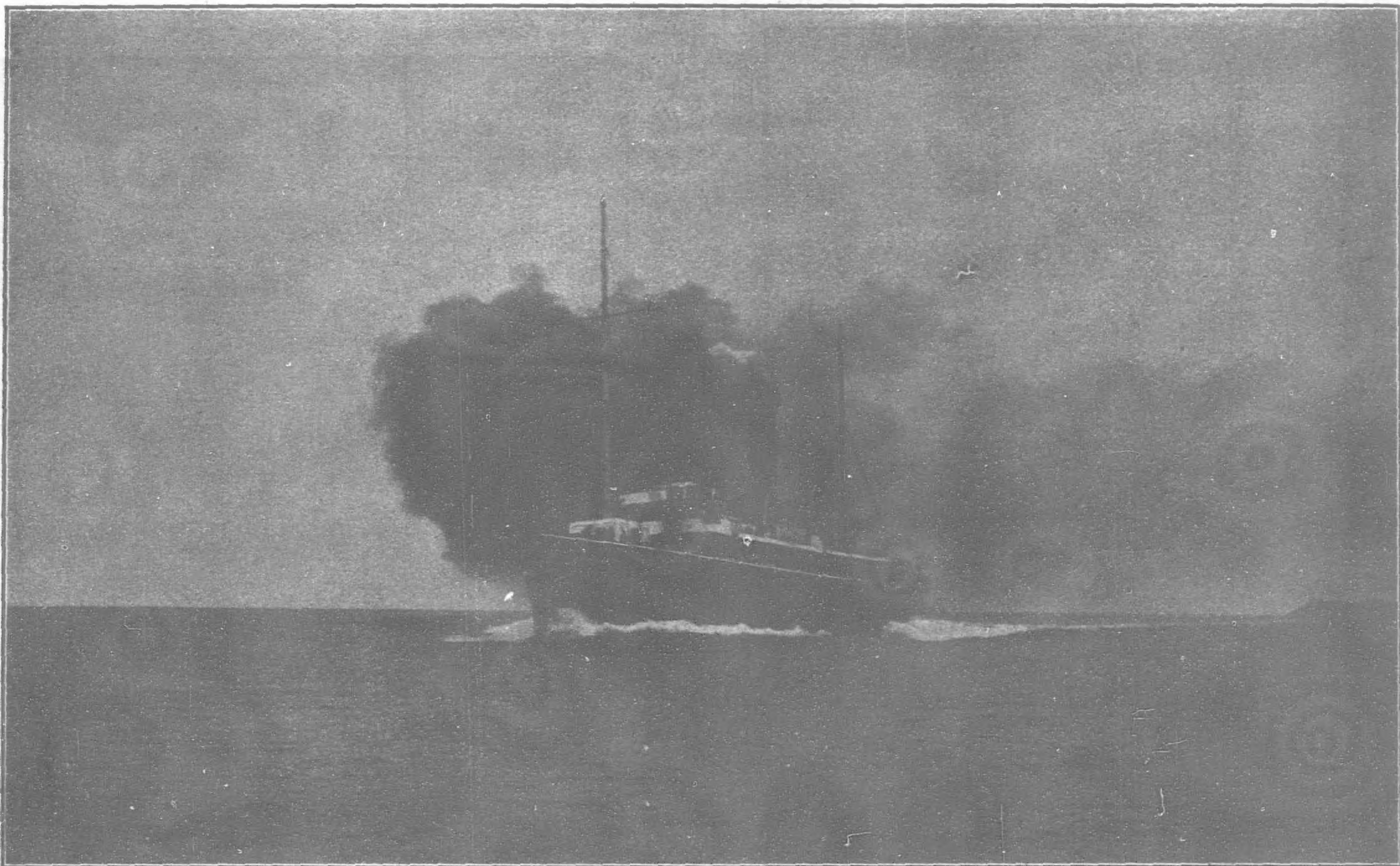


TATGAMI SHIPYARDS OF THE MITSU BISHI COMPANY AT NAGASAKI



150 TON CRANE AND AKONOURA ENGINE WORKS OF THE MITSU BISHI COMPANY OF NAGASAKI





IMPERIAL JAPANESE VOLUNTEER FLEET STEAMER "SAKURA-MARU."—Built and engined by Mitsu Bishi Dockyard and Engine Works, Nagasaki, October 1908, to the requirements of the Imp. Japanese Government Rules.—Length, 335 feet 0"; Breadth, 41 feet 0"; Depth, 31 feet 6"; Gross tonnage, 3200 tons; Displacement, 3880 tons; Engines, Parsons' Three Shaft Steam Turbines; Boilers, Miyabara's Water Tube Boilers (6); I. H. P., 8500; Speed, 21 knots.; Shipowners, Imperial Japanese Marine Association; Armaments, 2 6-in. guns, 6 12-pounders; Wireless Telegraph on fore mast; 2 search lights, each 20".  
(This photo was taken on her full speed trials which took place on 26th September, 1908)

them from the racks and passing them to the trucks for conveyance to the platers' sheds, etc.

To facilitate the conveyance of materials there are over two and a half miles of rails in the yard.

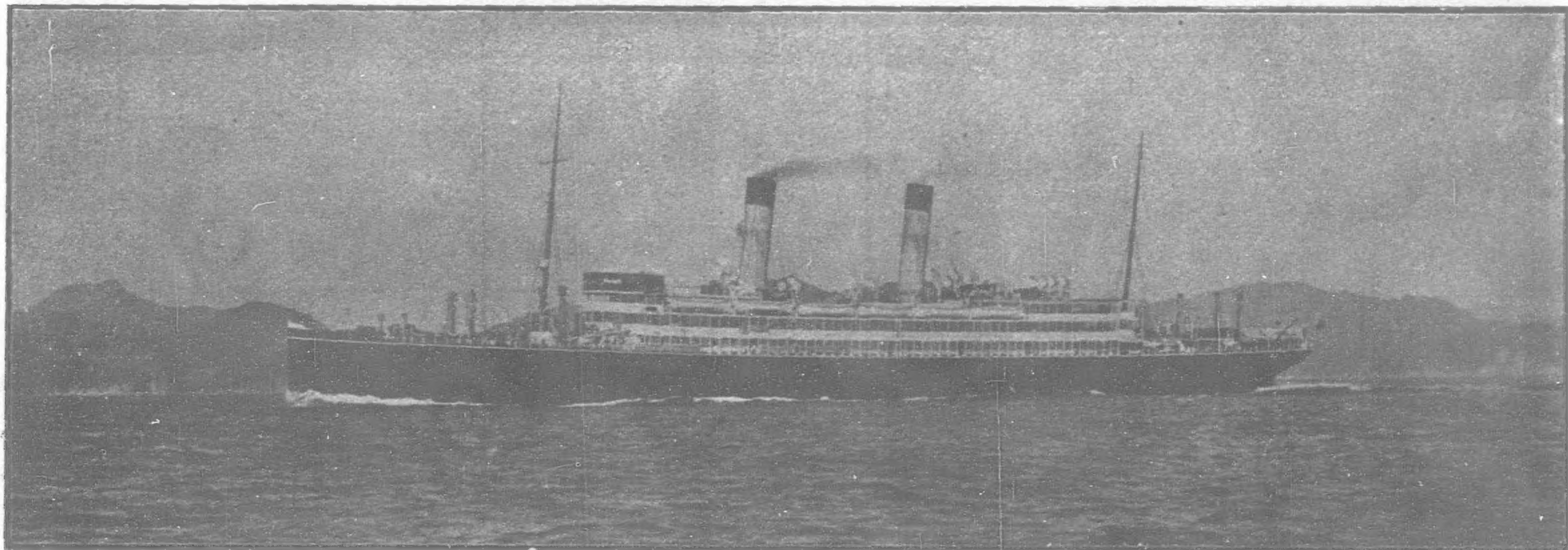
*Ship-Platers and Fitters' Department.*—Dealing with the separate departments, one naturally begins with the moulding loft, where the work of construction is begun in the case of all ships. The length of this loft is 380 ft., and its width is 70 ft., the roof being of light steel principals with corrugated iron on the purlins, and ample daylight being admitted by glazed top and sides. The space below the loft is partly used as a

scribe board and partly as a platers' machine shop.

In the frame bending shop, which is about 140 ft. square, there are two angle furnaces, each 66 ft. long, one plate furnace 30 ft. long, and two angle bevelling machines, with about 4,800 sq. ft. of cast iron blocks for setting the frames, as well as the scribe boards for laying them out.

The platers' machine shops, which cover an area of over 54,070 sq. ft., are equipped with 14 punching and shearing machines, ranging up to tools which shear  $1\frac{1}{2}$  in. plate and punch  $1\frac{1}{2}$  in. holes in the same thickness, while the gap is 36 in. enabling plates 6 ft. wide to be

worked on. There is one hydraulic manhole punch capable of working holes 28 in. by 20 in. There is a large hydraulic flanging machine for setting plates for the keel and garboard strake as well as for stiffening flanges in bulkheads, which is capable of dealing with plates up to 24 ft. long, and up to the thickness of 1 in. There are three sets of bending rollers dealing with plates up to 25 ft. long. The planing machines number eight, and are all of considerable capacity. For straightening plates there is one mangle with solid steel rollers, taking plates 6 ft. wide and 1 in. thick. There are also plate scarphing, joggling, hydraulic bar cutting and other machines. There are



THE "TENYO MARU" BUILT AND ENGINED BY THE MITSU BISHI DOCKYARD & ENGINE WORKS, NAGASAKI



nine countersink drilling machines. Almost all of the tools in this shop are of British make, and the majority of them are directly driven by electric motors.

The beam bending shed is 90 ft. long by 35 ft. wide, and in it there are one beam bending and punching machine, two beam bending machines, one beam bending and angle cutting machine, one angle and channel cutting machine, two cold iron saws, etc., all operated by electricity.

The ironworkers' shed is on the south side of the yard, and contiguous to the building berths. It is 85 ft. long by 65 ft. wide, and contains one angle cutting and plate and angle planing machine, one countersink drilling machine, one plate bending and straightening machine, two plate straightening and flattening machines, two punching and shearing machines, etc.

The blacksmithy is 262 ft. long by 40 ft. wide. In it there are 35 smith fires, the blast being supplied by three Root's blowers. There are ten steam hammers ranging up to 20 cwt., and one 5-cwt. steam striker; also three rivet-making machines, the largest of which is capable of turning out three tons per ten hours.

The angle smith shop, 175 ft. long and 40 ft. wide, contains 28 fires with two centrifugal blast fans, driven by electricity.

The galvanising shop is adjacent to the blacksmith shop. The building is 100 ft. long and 40 ft. wide. There are five zinc baths, the largest being 22 ft. by 2 ft. 2 in. by 5 ft., one refining furnace, and four water baths.

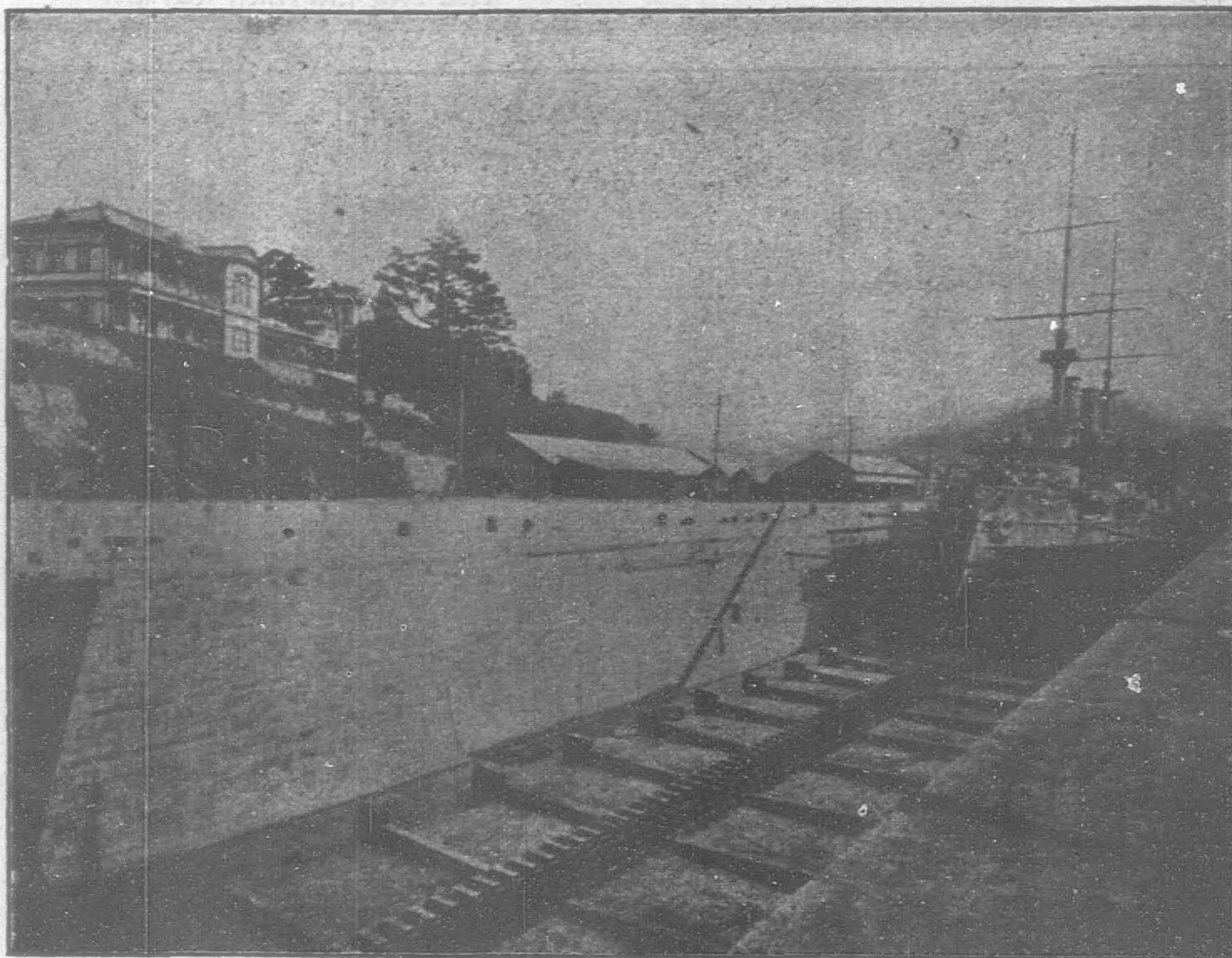
The machine shop is placed contiguous to the building berths. The shop is 140 ft. long by 60 ft. wide. There are fourteen drilling machines of various types; also the same number of lathes of numerous kinds, boring and turning machines; shaping, slotting, milling and surface planing machines; cold iron band sawing machines, Solber patent screwing machine, screw cutting machines, bolt and nut screwing machines, lag screwing machine, and emery grinding machines, etc. All the machinery in this shop is driven by two electric motors, each of 40 b. h. p.

*Woodworking Department.*—As can readily be imagined, in an establishment which turns out first-class passenger steamers the woodworking department is very extensive.

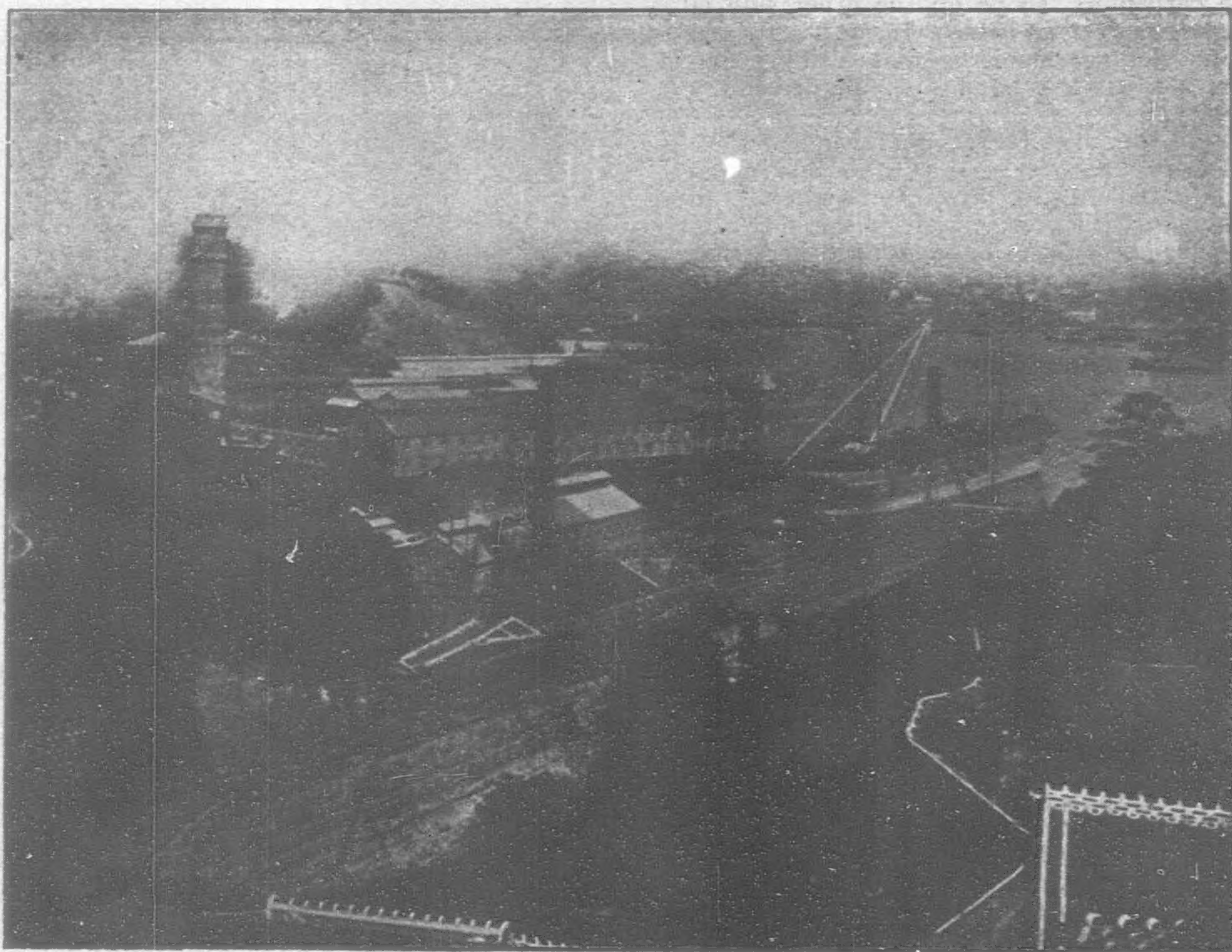
The whole timber department occupies about five acres of ground, about one-third of which is covered in with drying sheds. The timber for the joinery department is accommodated in sheds covering 3,800 square yards. The buildings for deck stowage cover 1,760 square yards.

The saw mill is situated at the extreme north end of the shipyard. The building is a light wooden structure measuring about 100 ft. long by 70 ft. broad. The log department is fitted with three vertical saw frames. In the resawing and dressing of the wood, the principal machines used are two four-side planing machines, one circular saw, endless band sawing machine, reciprocating cross cut saw and dowel making machine, etc. In the saw room there are two saw sharpening machines and one band saw sharpening machine. The majority of the machinery in the mill is driven by electricity.

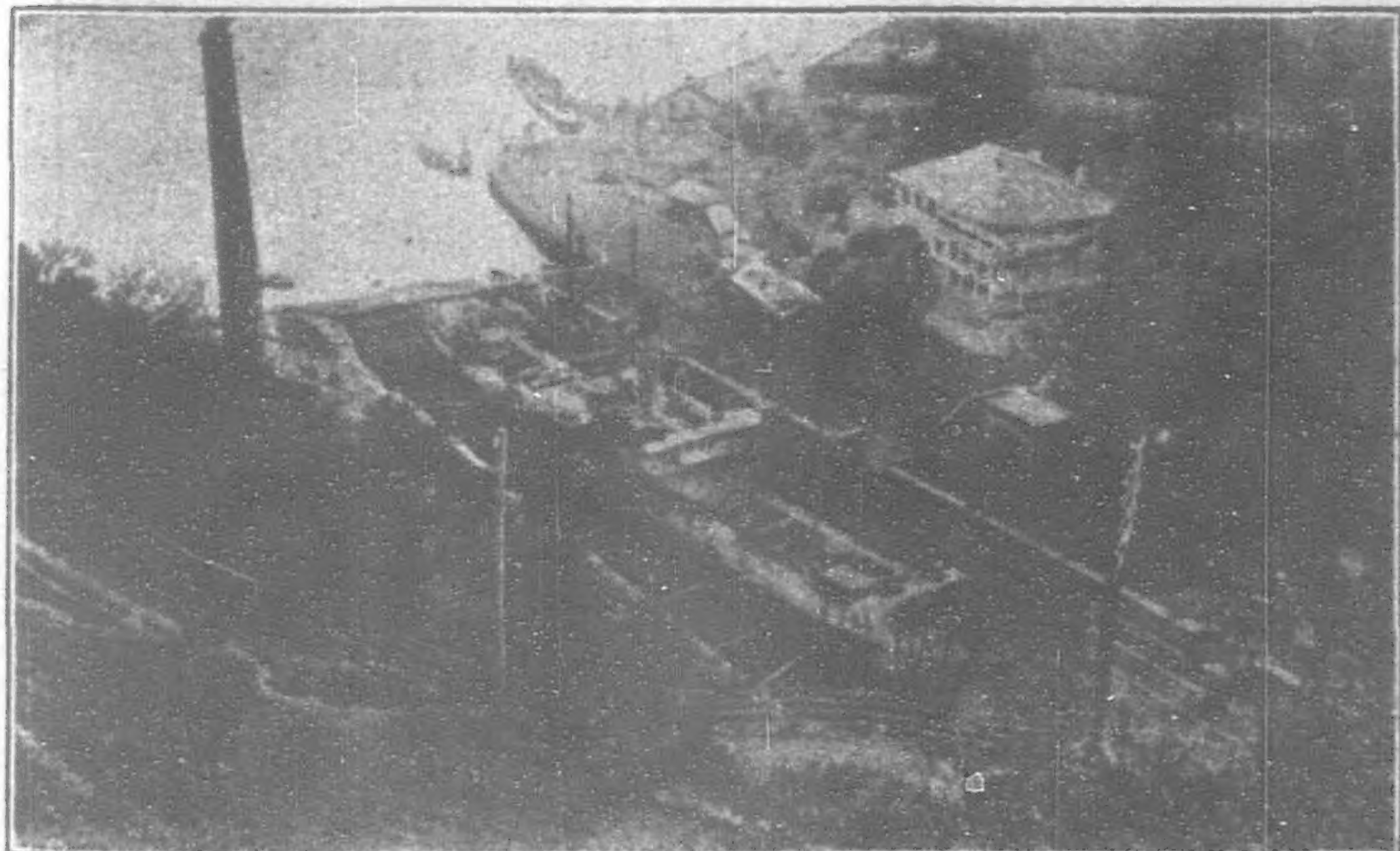
The joiners, cabinet makers and polishers are accommodated in a two-story building situated at the side of No. 1 Dock. It covers a working space of 80,440 sq. ft. The collection of wood working tools is complete and represent-



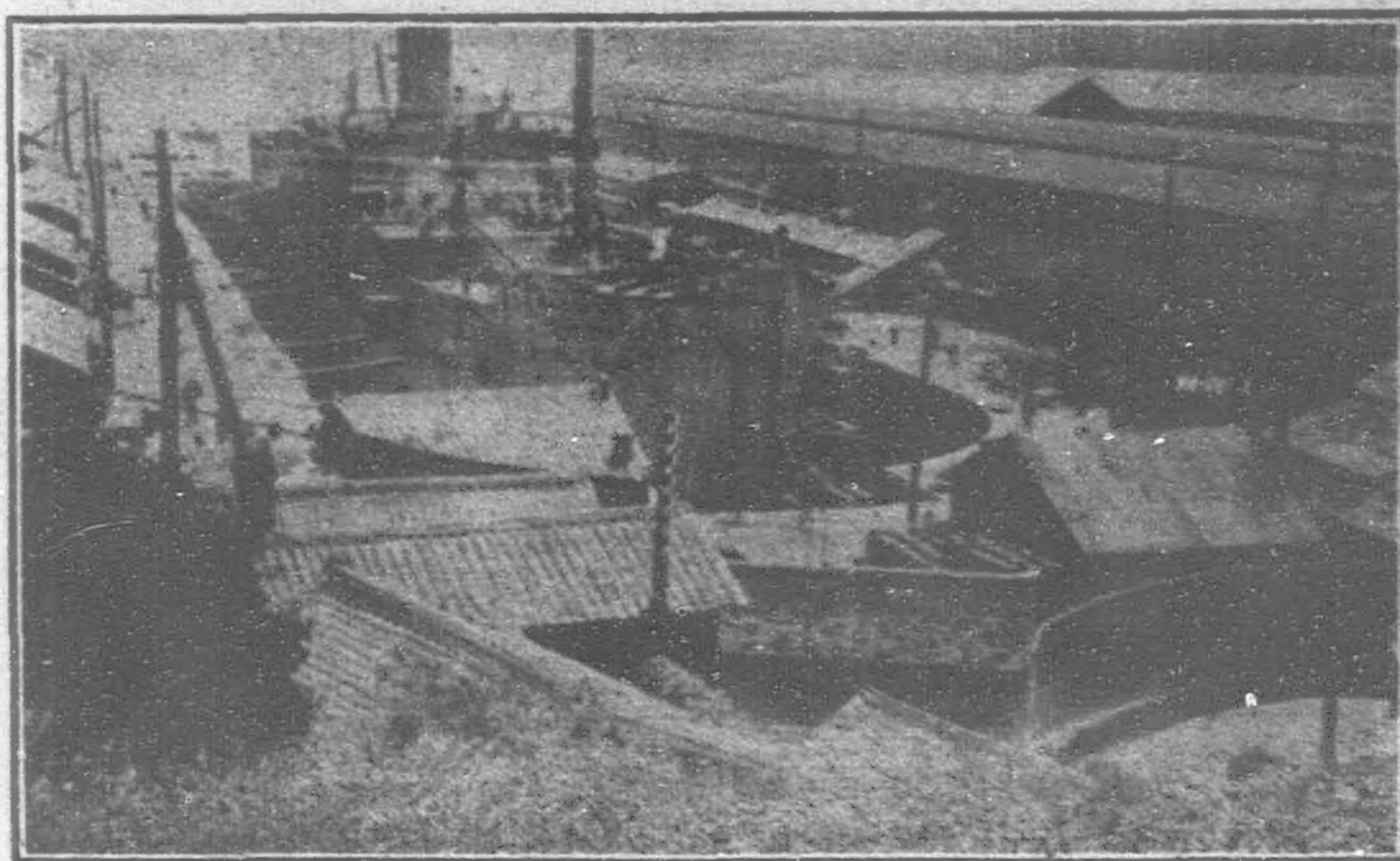
MITSU BISHI'S NO. 3 DOCK (714 FEET ON BLOCKS) WITH H. I. J. M. WARSHIP "IKI" ON THE STOCKS



ENGINE WORKS OF THE MITSU BISHI DOCKYARD AND ENGINE WORKS, NAGASAKI, SHOWING 100 TON SHEERLEGS WITH WHICH THE STEAMER "HITACHI MARU," 7,500 TONS GROSS, BUILT AT ITS PLANT, IS BEING EQUIPPED

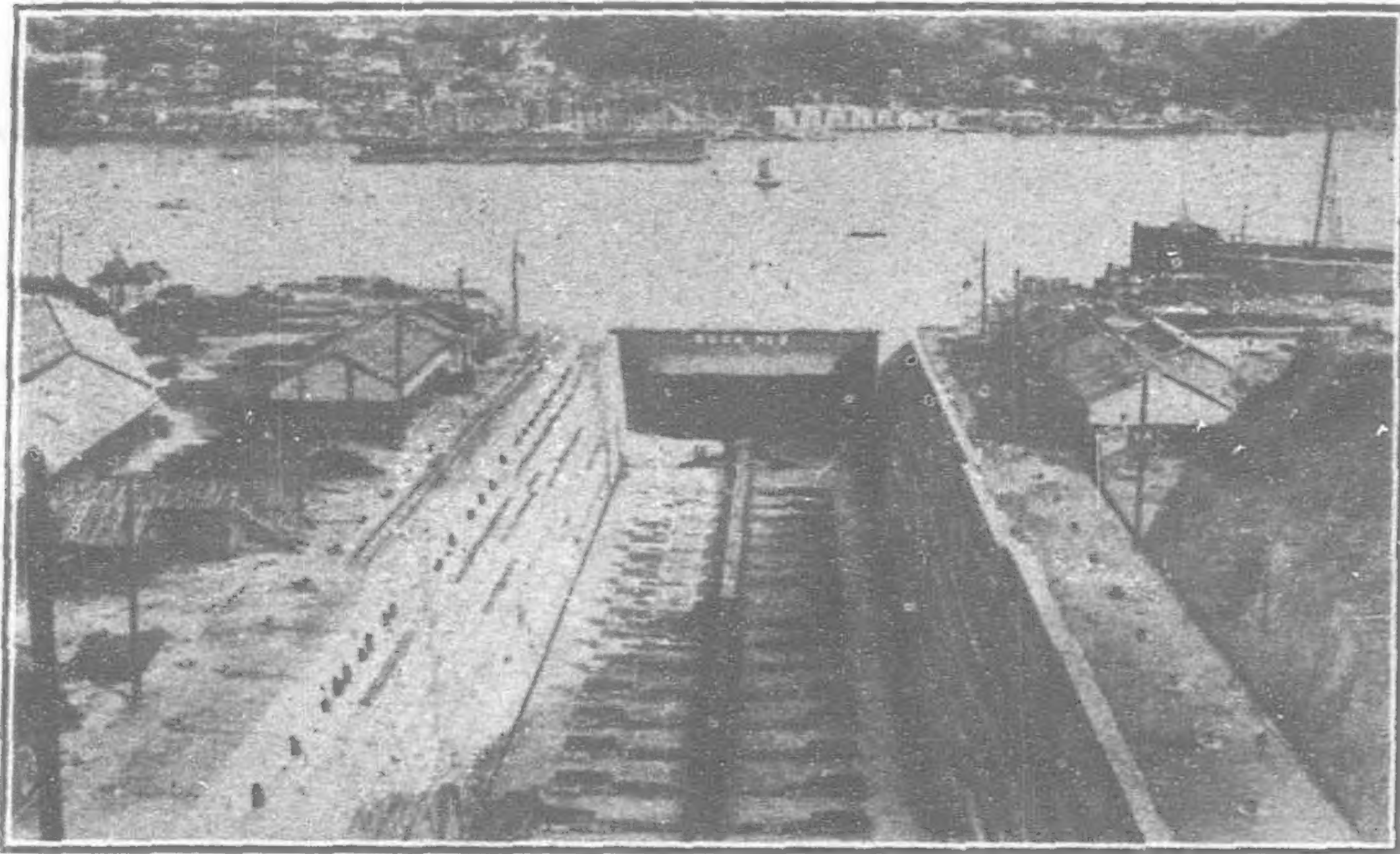


THE NO. 2 DOCK OF MITSU BISHI CO., NAGASAKI

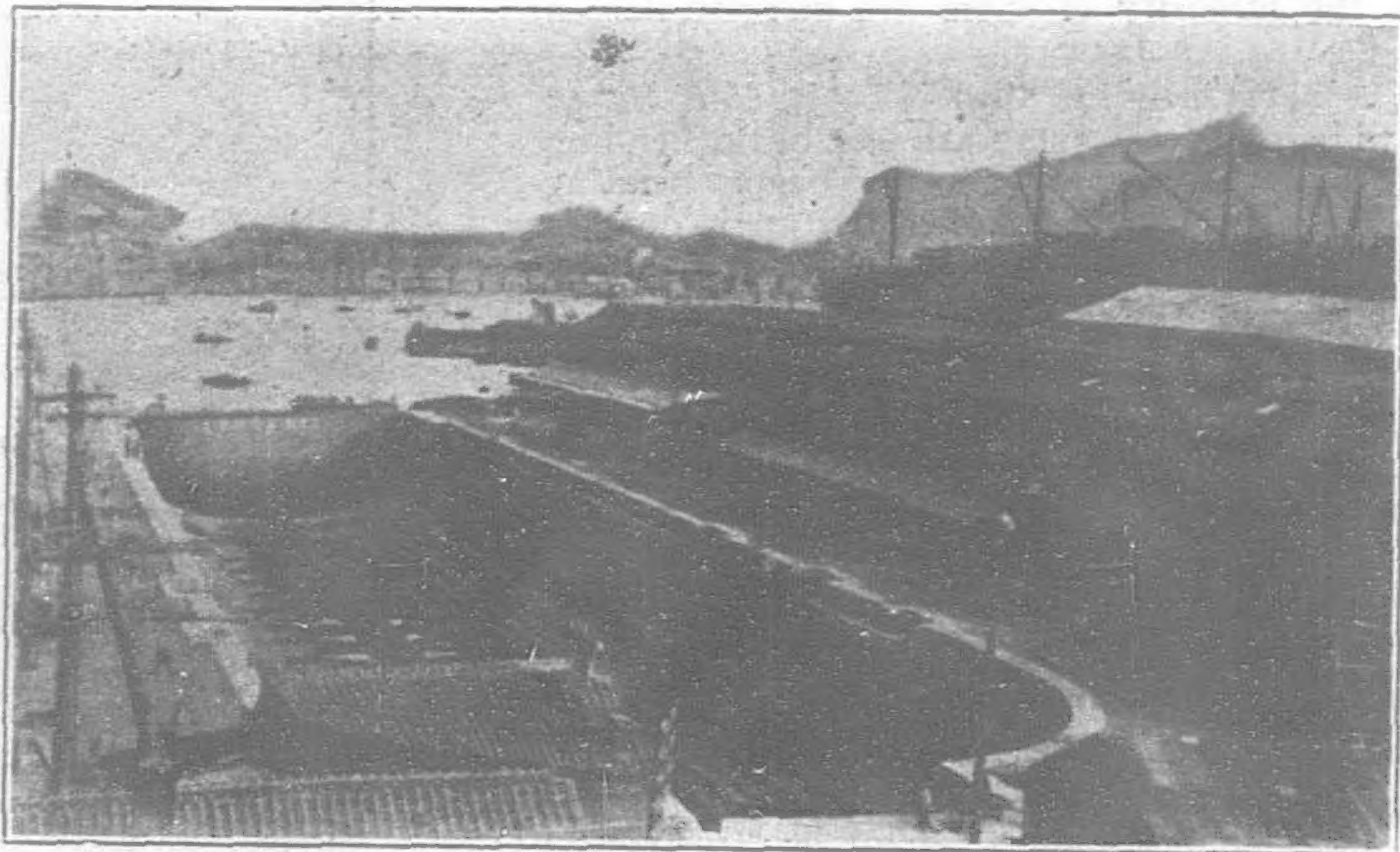


THE NO. 1 DOCK OF THE MITSU BISHI CO.





DOCK NO. 3 MITSU BISHI CO.



THE NO. 1 DOCK OF THE MITSU BISHI CO.

ative of the best British practice, including circular saw bench, three endless band saws, scroller fret saw, planing and thicknessing machine; power and hand feed planing machine, three planing and jointing machines, scraping machine, eight moulding machines of various types, dove-tailing machine, five sand-papering machines of different types, buffing machine, two tennoning machines, five morticing machines, rounding machine, two wood turning lathes, wall drilling machine and emery grinding machine, etc. The machinery is driven by four electric motors of 146 total b. h. p.

The carpenters' shops on the other side of No. 1 Dock cover an area of 18,750 sq. ft. and contain planing, moulding and drilling machines; also endless band saw, all driven by electricity.

GRAVING DOCKS AND SLIP.

There are three graving docks, all constructed of granite, and one slip. No. 1 Dock is nearest to the shipyard; then No. 3 and No. 2. The slip is at Kosuge. It may be mentioned here that No. 1 Dock was constructed by the former owner, but was lengthened by the present proprietors in 1895. The following are the principal dimensions of the docks:—

	Feet	Ins.
No. 1 Dock.		
Length on keel blocks.....	510	0
Breadth at entrance on top.....	89	0
Breadth at entrance on bottom.....	77	0
Depth of water on blocks at ordinary spring tide.....	26	6
No. 2 Dock.		
Length on keel blocks. ....	350	0
Breadth at entrance on top.....	66	0
Breadth at entrance on bottom.....	53	0
Depth of water on blocks at ordinary spring tide.....	24	0
No. 3 Dock.		
Length on keel blocks.....	714	0
Breadth at entrance on top.....	96	7
Breadth at entrance on bottom.....	88	7
Depth of water on blocks at ordinary spring tide.....	34	6

The patent slip is capable of lifting vessels up to 1,000 tons gross. The length of slipway rail is 750 ft., with width 30 ft.

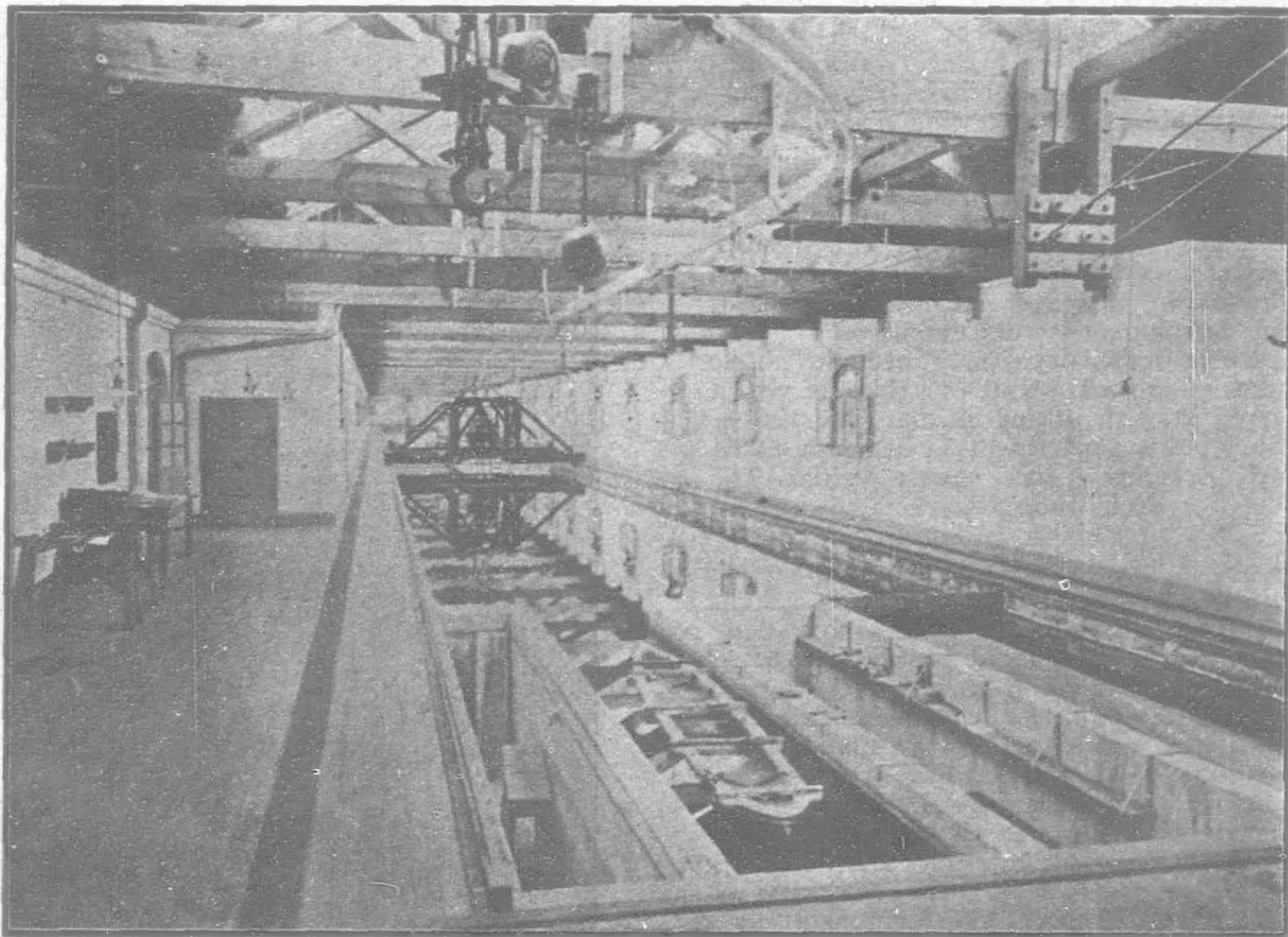
ENGINEERING DEPARTMENT.

We may now turn to the engineering department, which is arranged at the northern part of the works.

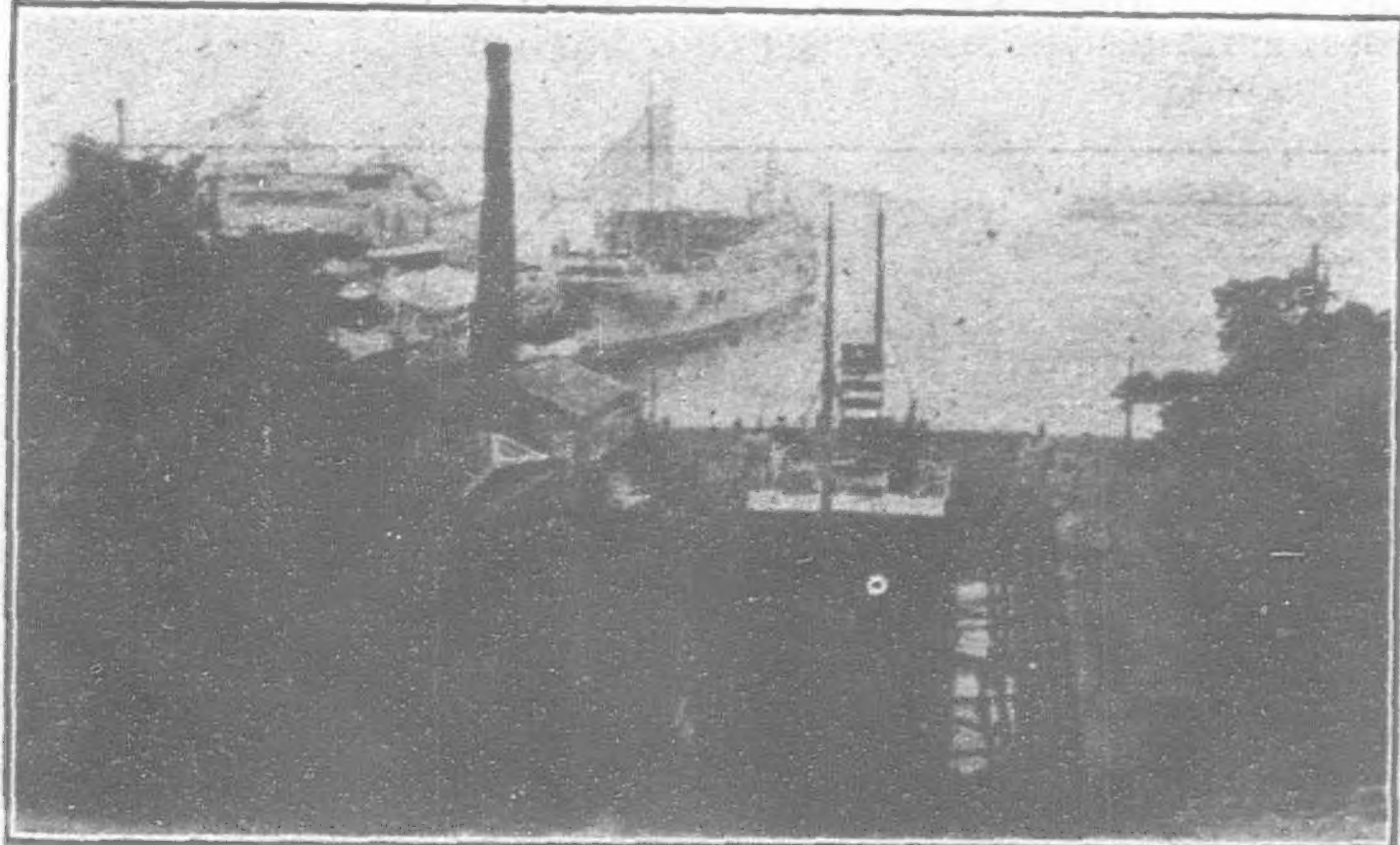
*Machine Shops.*—Machine shops, which cover an area of about 23,150 sq. ft., contain 124 lathes, three turning and boring machines, five screwing machines, five cutting-off machines, one nut tapping machine, one bolt turning machine, one stud machine, nine planing machines, seven shaping machines, six slotting machines, one keyway cutter, 32 drilling machines three centering machines, one cylinder

boring machine, three boring machines, two oil groove cutting machines, 15 milling machines, one nut side facing machine, two band sawing machines, one circular sawing machine, and 16 grinding machines.

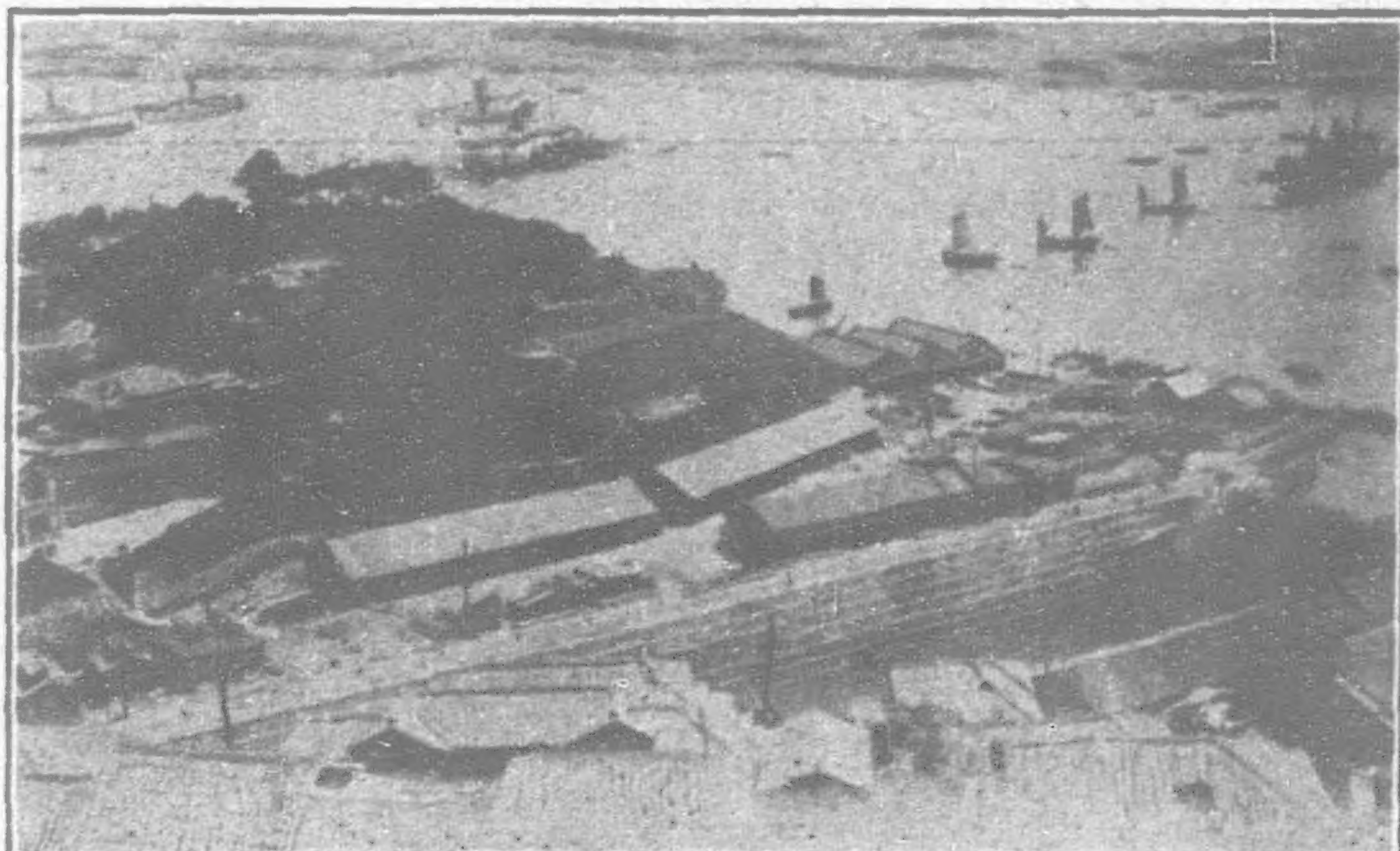
Of the above, special mention should be made of an electrically driven quadruple geared crank shaft turning lathe, having a height of centres 54 in., length of bed 42 ft., and admitting between centres 27 ft. 3 in., two treble geared shafting lathes, each having a height of centres 20 in. and length of bed 36 ft. 6 in., and admitting between centres 28 ft. (these, having



EXPERIMENTAL TANK AT THE MITSU BISHI WORKS



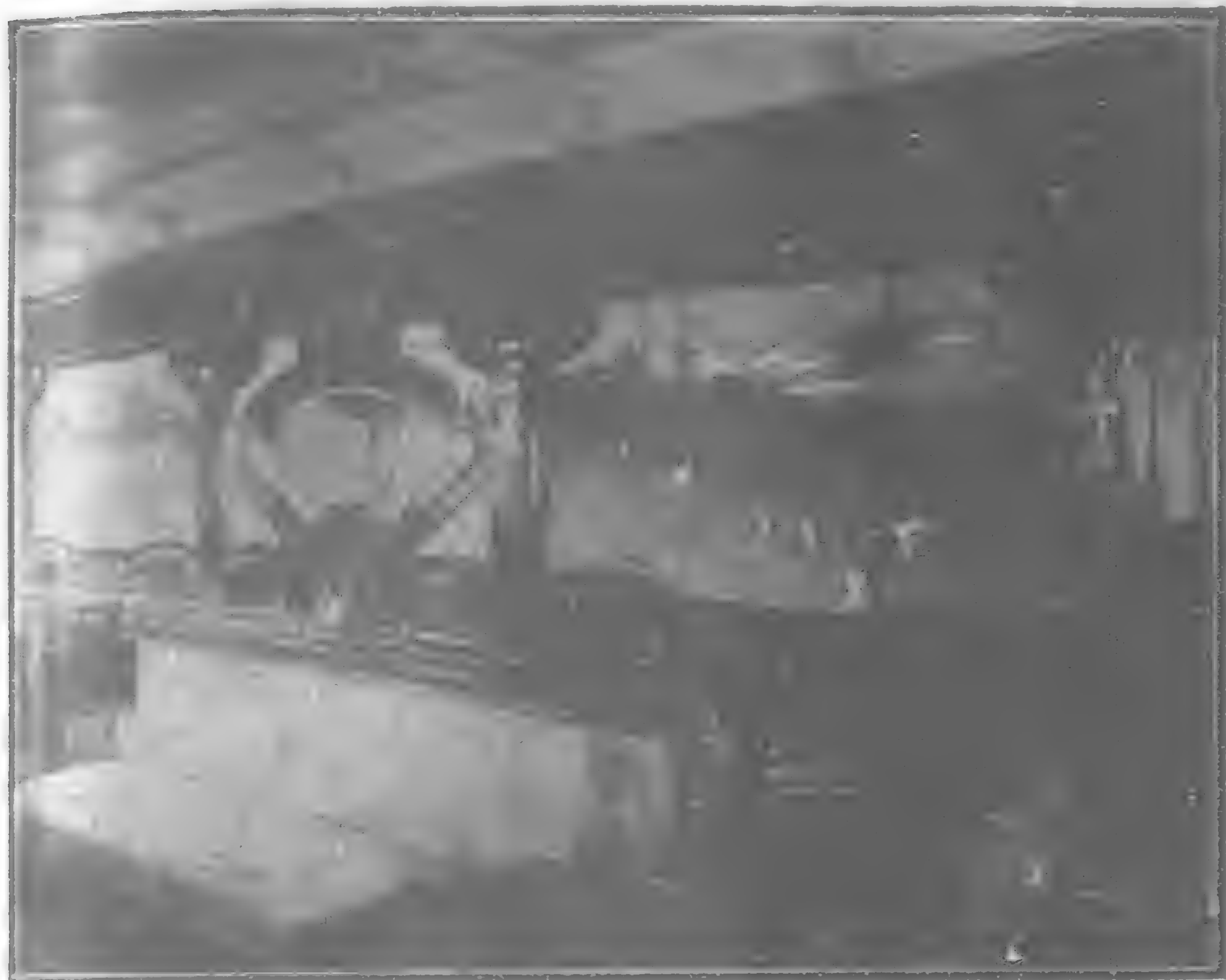
THE MITSU BISHI DOCK NO. 2, NAGASAKI



THE NO. 3 DOCK OF THE MITSU BISHI CO.



# INTERIOR VIEWS OF S. S. TENYO MARU



LOUNGE



1ST CLASS DINING SALOON



READING ROOM, TENYO MARU



DRAWING ROOM

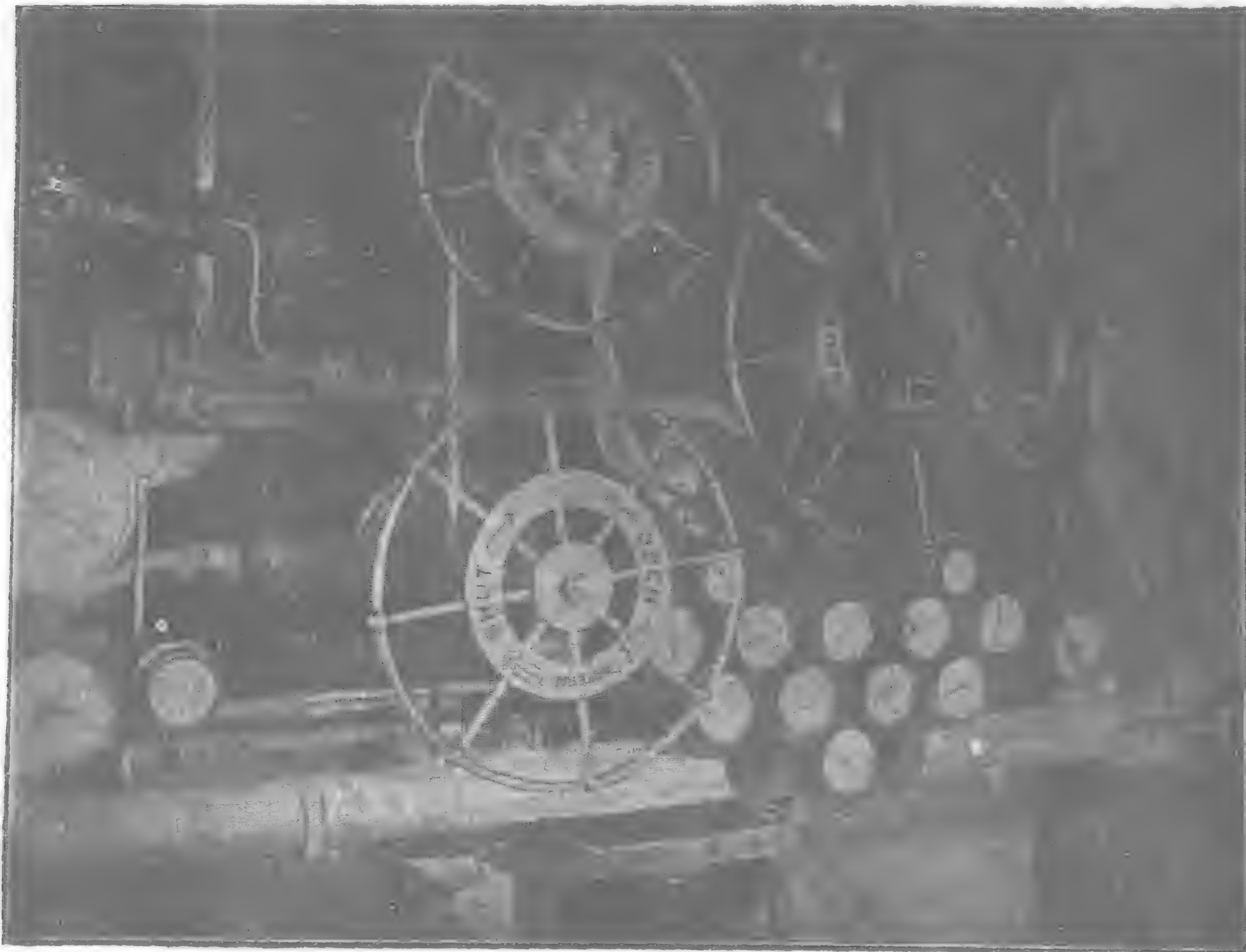


SMOKING ROOM



READING ROOM





VIEW OF ENGINE ROOM, TENYO MARU



ANOTHER VIEW OF ENGINE ROOM, TENYO MARU

a common centre line when combined together, are capable of turning up to 68 ft. 6 in.); one electrically driven vertical cylinder boring

machine, capable of boring cylinders up to 100 in. in diameter; one electrically driven double-headed universal horizontal drilling, boring

tapping, studding and milling machine, commanding 10 ft. vertically and 20 ft. horizontally, with spindle  $5\frac{1}{2}$  in. in diameter; also one horizontal and vertical planing machine, having a horizontal stroke of 21 ft. and a vertical stroke of 18 ft., driven by 25 b. h. p. motor. The machine shop is equipped with one 20-ton, one 15-ton and three 5-ton electric overhead travelling cranes.

**Turbine Shop.**—The turbine shop, which is 243 ft. by 102 ft., contains four lathes, one turning and boring mill, two planing machines, one slotting machine, one turbine machine, one turbine blade cutting machine, four drilling machines, one turbine cylinder boring machine, one turbine blade nicking machine, one turbine packing strip cutting machine, one special dovetail milling machine, one special milling device, five turbine blade tipping machines. Special features amongst the above machinery are one large electrically driven quadruple gear double bed lathe for turbine rotor turning, having a height of centres 68 in., which may be raised to 79 in. by using a lever, and length of bed 51 ft., admitting between centres 36 ft.; one electrically driven pit planing machine, capable of planing 36 ft. in length, 14 ft. 6 in. in width and 7 ft. 6 in. in height; one electrically driven turbine cylinder boring machine, to bore up to 13 ft.; and one electrically driven powerful slotting machine, having a stroke of 48 in.

The machinery in this shop is all driven by electricity. There are two 50-ton and one 60-ton electric overhead travelling cranes in the shop.

**Electing Shop.**—Electing Shop and Machine Shop.—The building is 67 ft. 11 in. by 116 ft. 2 in., and is very lofty. There are three main bays, which are occupied respectively as electric shop, electing shop, and fitting shop. The electing shop has sufficient space to erect three twin sets of 8,000 i. h. p. triple expansion engines simultaneously, and is equipped with one 30-ton and one 20-ton electric overhead travelling cranes. The Fitting Shop has one 10-ton crane of the same type.

The water testing and shrunk-on work shop, which is 80 ft. by 130 ft., is equipped with a complete set of pumps, gears for water testing and shrunk-on work, and a 20-ton electric overhead travelling crane, and is always in readiness to carry out water testing and shrunk-on work.

**Boiler Shops.**—The boiler shops adjoin the turbine shop. The buildings cover an area of 53,282 sq. ft. of ground, and are divided into four sheds, one for machine work, one for boiler construction, one for hydraulic riveting, and one for flanging. There are several very powerful tools, notably one 125-ton hydraulic riveter with 40-ton hydraulic crane and 8 ft. gap; one 150-ton hydraulic flanging machine with 4 ft. gap; one vertical plate bending roller, to deal with a plate 11 ft. 6 in. wide and 2 in. thick; one electrically driven boiler shell drilling machine, which can take one double-ended boiler up to 16 ft. in diameter and 18 ft. in length or two single-ended boilers each 16 ft. in diameter and 12 ft. 6 in. in length; one 2-spindle boiler shell drilling machine, to deal with boilers up to 16 ft. in diameter and 18 ft. in length; one 4-spindle boiler shell drilling machine, to deal with boilers up to 16 ft. in diameter and 23 ft. 6 in. in length; one electrically driven lever punching and shearing machine with angle cutter, punches  $1\frac{1}{2}$  inch hole through  $1\frac{1}{2}$  in. plate, shears  $1\frac{1}{2}$  in. plate, and cuts angles 6 in. by 6 in. by 1 in., with punch gap 36 in. and shear gap 33 in.; one edge planing machine, capable of planing plates up to 30 ft. horizontally.

Besides the above, special features of this shop are: one large 30-ton portable hydraulic riveter with 7-ft. gap; one oval and round hole cutting and marine boiler flange and flue turning machine, to take boiler end plates from 7 ft. 6 in. to 17 ft. in diameter; and one portable electrically driven drilling and boring machine. For conveyance, the shop is equipped with four 40-ton and one 7-ton electric overhead travelling cranes, two 5-ton hydraulic wall cranes, and 11 hand and wall cranes ranging from 1-ton to 5-ton lift.





SOCIAL HALL, ATSUTA MARU



SMOKING ROOM, ATSUTA MARU





**Smith's Shop.**—The engine works smith shop, which is 375 ft. by 60 ft., is a light steel structure with 23 single hearths, five double hearths and seven forges arranged in rows on either side of the building, and with nine steam hammers, ranging from  $1\frac{1}{2}$  tons to 7 tons, arranged in centre line. There are 5-ton, 10-ton and 20-ton air furnaces. The shop is equipped with 12 cranes ranging from  $1\frac{1}{2}$  tons to 20 tons. There is also one steam driven plate shearing machine.

**Copper Smith Shop.**—The copper smith shop, a temporary building of 144 ft. long by 72 ft. wide, is equipped with one hydraulic pipe bending machine, one upright drilling machine, one horizontal radial drilling and tapping machine, one flanging, rolling, straightening and circular cutting machine, one punching machine, one capstan lathe, one hack saw one air hammer, one plate bending roll, one pipe threading machine and one shearing machine. There are 12 hearths, the blast being supplied by Root's blower with 31 b. h. p. electric motor and capable of supplying 640 cubic ft. of air per minute.

**Foundry.**—The foundry is situated to the north of the machine shops. It consists of two main parts: iron and steel foundry and brass foundry. The iron and steel foundry is 310 ft. long by 102 ft. wide. The equipment includes a 2-ton Siemen's steel gas furnace, four cupolas with a casting capacity of 50 tons, one annealing furnace and three drying furnaces, each 20 ft. long and 16 ft. wide, and one sand mill. Two 15-ton and one 30-ton electric overhead travelling cranes and 14 3-ton radial cranes are distributed conveniently. There are six moulding pits, the two largest being 25 ft. by 30 ft. by 7 ft., and 20 ft. by 20 ft. by 12 ft.

The brass foundry is 100 ft. long by 102 ft. wide, containing two Stone's manganese air furnaces of 8-ton and 5-ton capacity, with moulding pit of 12 ft. by 12 ft. by 7 ft. on iron and steel foundry side, so that the heavy overhead cranes in the iron and steel foundry may be utilized for this pit. Six brass crucibles of forced draft and four of natural draft, each of 200 lbs., and two drying ovens. There are eight radial cranes distributed over the foundry, each of 3 tons capacity. At the corner of the Brass Foundry is the Core Shop.

The foundries are completely self contained in every sense, the moulding boxes and plates, core bars and core irons, etc., being all made there. Adjoining the foundries there are the requisite stores for metal, sand, furnace coal, coke, etc.

The pattern shop, which is a brick building, 180 ft. long by 70 ft. wide, is equipped with one circular and one band saw, one planing machine and four wood lathes, all driven by electricity. The first floor is used for storing the patterns; there is also at the back a spacious pattern store for large old patterns.

#### RIGGING AND SAIL LOFT.

The rigging and sail loft is a two story wooden building, 100 ft. by 50 ft. The ground floor is occupied by the riggers, where all rigging ropes, blocks, tackles and other materials required by them are prepared. The first floor is entirely used by sail makers.

#### ELECTRIC SHOP.

The electric shop comprises one wing of the erecting shop, the ground, first and second floors, covering a working area of about 22,200 sq. ft., for production of all kinds of electrical machinery and fittings, especially Parsons' turbo-generators.

There are over 50 machines of the most improved and latest type, capable of undertaking both marine and land work. There is also an electro-plating department in this shop.

#### GIANT CRANE.

On the jetty, for shipping engine and boilers, etc., from the engine works, there is a 150-ton hammer-head type electric giant crane, designed by Messrs. Applebys Ltd., of Glasgow and London. It consists of a square tower, 136 ft.  $3\frac{1}{2}$  in. in height and 40 ft. square at the base, carrying a large roller path on top, upon which a horizontal jib, having a total length of 239 ft.  $9\frac{1}{2}$  in. is supported. The long arm of jib has a total radius of 156 ft. 6 in. The jib is fitted with slewing gear to revolve it in either direction, and has racking gear and separate lifting motions for the main and auxiliary hoists.

The speed of the various motions are as follows: Main lift, 150 tons at 6 ft. per minute; auxiliary lift, 50 tons at 18 ft. per minute;

racking, 150 tons at 30 ft. per minute; slewing, 150 tons one revolution in eight minutes. The total height of lift provided for is 171 ft.  $3\frac{1}{2}$  ins., that is to say, 141 ft.  $3\frac{1}{2}$  ins. above and 30 ft. below quay level. The total height from the quay level to the top of jib at the centre line of the tower measures 178 ft.  $5\frac{1}{2}$  ins. The racking and lifting machinery is placed in a steel-plated house at the tail end of the jib, and assists in counterbalancing the crane. The slewing gear is placed in a steel-plated house over the circular rack at the back end. The operator's cabin of steel plating, containing controller and resistance is placed on the centre line of girders of the jib, and is provided with projecting windows so that a clear view is obtained of the load at all times.

It is connected to the machinery house by speaking tubes, and by telephone to the ground.

The works are also provided with a 30-ton floating sheerlegs.

#### SALVAGE DEPARTMENT.

The works own the salvage steamer *Oura Maru* of 716 tons and 12 knots speed, built especially for the purpose, and fitted with one 18 in. and three 12 in. centrifugal pumps, one 8 in. and one 4 in. special pumps, with all necessary gear of the most powerful description, being always ready with an experienced staff of workmen and divers to undertake salvage work at short notice.

#### EXPERIMENTAL TANK.

The comparatively recent addition of a ship model experimental tank to the works is but further evidence of progressive character of the management of the concern, and its utility is proved by the fact that since the tank was completed about a year and a half ago, it has been kept fully employed in testing models of ships past, present and projective, and of screw propellers. It is a noteworthy fact that there are only three properly equipped experimental tanks in the world belonging to private ship-building firms. The first is that of Messrs. Denny, at Dumbarton, the second, that of Messrs. John Brown & Co., at Clydebank, while the third is that now mentioned.

The arrangement and design of this great marine laboratory was entirely placed in the hands of Mr. Archibald Denny, of Dumbarton,



**S. S. PANAMA-MARU.**—First of three sister-ships being built at the Mitsu Bishi Dockyard & Engine Works, Nagasaki, to the order of the Osaka Shosen Kaisha for its American Service.—Principal Dimensions:—Length, 400' 0"; Breadth, 51' 0"; Depth, 32' 6"; Speed attained at her trials, 15 knots. Type of Engines:—1 set Triple Expansion Engines; Boilers, 4 Single Ended Scotch Boilers fitted with Howden's Forced Draft. Passenger Accommodation:—1st Class 8, 3rd Class, 180.



and is practically a reproduction of the Clydebank tank, with the improvements evolved from experience since the construction of that tank.

Therefore, it is rather interesting to know that the only three private tanks in existence are in one way or another related to each other.

The waterway extends for 430 ft., of which 280 ft. is deep, varying from 12 ft. 6 in. at the north end to 12 ft. at the south end. This fall of 6 in. is gradual, and is for the purpose of drainage when emptying. The breadth is uniformly 20 ft. At the north end there are wet and dry docks. Of the wet docks, one is for storing models, and the other, placed between dry docks, is used for loading and trimming purposes. The towing truck can be run over the centre dry dock and the dynamometer and propeller gears examined from it. The latter must be raised to clear the dock sill. Ballast bags and spare parts are stowed in both dry docks. At the south end there is a sloping beach, 25 ft. long, to assist in breaking up the waves formed by the passage of a model through the water. A recess, however, is left up the middle, to prevent screws or models being run aground. The basin, which is rectangular in cross section, is formed of concrete and puddled clay backing.

The building is of brick, and, besides containing the tank proper, provides accommodation for a drawing office and superintendent's office, with the necessary fireproof record room, etc. In addition to the usual workshops necessary for tank work, there is a well-equipped mechanics' shop. Thus wood and metal work of any kind can be prepared, divulging nothing about the nature of the research work carried on within the walls of the tank.

As it is necessary to keep the temperature of the tank at or about a uniform degree, a complete system of hot-water piping is installed, and the heat is controlled at the calorifiers, of which there are two at the south end, and one at the north end of the building.

The offices and shops are heated on the same system. Light is admitted to the tank by windows on both sides and from the roof, most of which is glazed, while a complete system of electric lighting is installed throughout the building. The models used are generally about 12 ft., although exceptions are made according to the nature of the experiments required.

Like the Clydebank tank, the tank carriage is electrically driven. Current is supplied from the central power station, but, as it would be too irregular if applied direct, it is passed through a motor generator into secondary batteries, from which it is again discharged through the motor generator at a suitable and regular voltage, and delivered to the tank.

The trolley wiring is on the ward Leonard system. The tank carriage with its apparatus, and the model cutting machine and other accessories for the tank work were constructed and supplied by Messrs. Kelso & Co., Glasgow.

#### TESTING HOUSE AND CHEMICAL LABORATORY.

The works is installed with a Buckton's 50-ton testing machine and a 100-ton chain testing machine; also a well appointed chemical laboratory for the analytical examination of materials.

#### POWER PLANT.

*Electric Plant.*—An interesting item in the arrangement of such a large establishment is the system of generating and distributing power. Electricity is used on an extensive scale, not only for the lighting of workshops, sheds, the interiors of ships under construction, and of the yard generally, but also for the driving of the machine tools.

The central power house at Akunoura is fitted with two 500 k. w. turbo alternators direct coupled to Parsons' turbines one 500 k. w. direct current generator coupled to Willans' patent central valve engine, two 100 k. w. direct current dynamos coupled to the same type of engines, two 225 k. w. direct current dynamos coupled to a McIntosh, Seymour & Co.'s vertical cross compound engine, and 300 k. w. direct current dynamo coupled to three-phase induction motor; also two 25 k. w. dynamos coupled to one three-phase induction motor and used for ship lighting, and 100 k. w. booster

or motor generator which is used for charging the secondary batteries, having a capacity of 3,000 ampere hours. The steam is supplied by seven Babcock & Wilcox boilers, which also serve as destructors, being used for disposing of the sawdust, shavings, etc., from the various wood-working shops, and the rubbish collected from the interiors of ships under construction.

The sub-station at Tategami shipyard is fitted with two 200 k. w. rotary converters and six 75 k. w. transformers, which convert from 3,450 volts alternating current to 250 volts direct current.

There are in the works about 260 arc lamps of 193,500 watts, and 2,800 incandescent lamps of 16 candle power. The arc lamps are used principally for outside illumination, and in the interior of the larger sheds and shops. The incandescent lamps are used in all the wood-working departments and offices, and for all bench work. They are also used for the internal lighting of ships during construction.

Electricity is largely used for machine tool driving, the power utilized in motors amounting in all to about 4,300 b. h. p. There are over 200 motors in use, varying in power from 200 b. h. p. downwards. In the first place, there are a number of high speed electric overhead travelling cranes in the machine and erecting shops, turbine shops and boiler shops, the largest being 60 tons. A large number of motors are applied to machines in machine shops, turbine shops and boiler shops; also to general shipyard work, such as shop driving, punches, shears, bending, cutting, planing and joggling machines, and to the machines in joiners' shops. Motors are also applied to the lighter class of work, for the purpose of driving portable drills, deck planers and ventilating fans on board ships under construction.

*Hydraulic Pressure.*—A hydraulic pressure system is installed throughout the shipyard, and is used for actuating the powerful flanging machine and manhole punching machine, several portable punches and riveters, and a number of cranes, etc. The pressure for this system is 1,500 lbs. per square inch. There is also a complete hydraulic installation throughout the engine and boiler shops, which is used for actuating the flanging machine and portable and fixed riveting machines, cranes and lifts. The pressure for this system is 1,200 lbs. per square inch.

*Pneumatic Plant.*—The pneumatic plant consists of one horizontal steam driven Rand Corliss air compressor, capable of delivering 593 cubic ft. of free air per minute, and two Ingersoll Rand's horizontal electrically driven two-stage air compressors, each capable of delivering not less than 215 cubic ft. of free air per minute, all having a terminal pressure of 100 lbs. per square inch. They are used for the lighter class of work in riveting, drilling, caulking and chipping, etc.

#### SCHOOL.

The works has its own school in the premises, having accommodation for three classes, totaling 150 boys, where they receive all the necessary elementary education to fit them for various trades and to make good workmen of them. The institution was organized by the goodwill of Baron Iwasaki, on the ground that an elementary, but thorough and sound, technical education is of the utmost importance to make good workmen, that being the main source of raising the industrial standard of the country.

The school is a fine brick building covering about 12,500 sq. ft., with a spacious recreation ground. The basement contains four large mess rooms, two cloak rooms, game lockers, lavatories and scullery. The first floor contains the hall, four class rooms, each with accommodation for 50 boys, one drawing class room, science class room, instrument and apparatus room, and instructors' retiring room and office. Large central spaces, leading to different rooms, both on the basement and first floor, so designed that the boys do not suffer from lack of recreation ground in rainy weather. The institution is open free to the general public, and, after going through the school curriculum, the boys are at liberty either to enter the works as apprentices or to take another course in life.

#### HOSPITAL.

A fine hospital, having accommodation for 50 patients, is also part of the works equipment. The appointment is perfect, and it is staffed with a number of experienced surgeons and physicians. Here injured employees receive surgical and medical treatment at the company's expense. The employees of the works have the privilege of free consultation, and of obtaining medicines of the very best kind at cost price. The hospital is fitted with an X-ray room and apparatus.

#### CLUB HOUSE.

The comfort of the employees is never overlooked by the firm, and, to provide for this, there is a large club house outside the Akunoura Works. This Club House is maintained entirely by the firm and is open to all the official staff, each paying only his own actual expenditure. There is, on the ground floor, a large billiard room with refreshment bar and three billiard tables. On the first floor there is a large library and reading room with over 1,500 volumes on all the engineering subjects and mostly of English publication.

#### PENSION AND SAVINGS BANK.

Pension and savings bank system, with other benevolent schemes, are in existence, to secure the welfare and to encourage thrift amongst the employees. A particularly noteworthy feature in connection with the workmen is styled "The Workmen's Protection Scheme," and has been in force since the end of 1897, with very satisfactory results. The scheme is based on the principle of an insurance system, and comprises three sections, viz.: "Injury," "Pension" and "Sick, Marriage, Birth and Death." For "Injury," the compensation extended to the workmen varies from £5 to £300, according to class and rate of wages to which they belong and to the nature of the injury, and is applied to the families of those who die or are incapacitated through injury received on duty. For "Pension" each employee deposits in the fund a certain proportion of his wage, to which the employers contribute a like amount. The pension granted from this fund to the workmen retiring from old age or other legitimate reason varies considerably, according to the grade and time of service; for example, the pension for those of ten years' standing varies from £9 to £70, according to grade, and for those of 25 years' standing from £40 to £300.

For "Sick, Marriage, Birth and Death," each employee also deposits a certain proportion of his wage, to which the employers contribute a like sum. The benefit accruing to the workmen by this fund varies from 2½d. to 2s. per day for four months for sickness, 14s. to £5 for marriage expenses, 4s. to £5 for birth or death of near relatives, and 10s. for conscription.

#### HONORS.

Gold Medals of Honor were awarded to the works at the 5th National Industrial Exhibition held at Osaka in 1903, and at the Tokyo Industrial Exposition held in 1907.

#### TUNG TAI TSEUNG KEE & CO.

This firm was started by Mr. Choi Chik Nam, in 1897, for the purpose of building and repairing steam launches, river craft, etc. Two workshops, one at Yaumati, and the other at Praya East, Wanchai, afford employment for five hundred workmen. The firm holds contracts from the French Government at Saigon, and is entrusted with the execution of repairs for the Indo-China, the Hamburg-America, and the Japanese lines of steamers. Upwards of a hundred steam launches have been built by this firm for Manila. One launch was 140 feet in length, and fitted with triple-expansion engines. The proprietor, Mr. Lan Fat, received his education in Hongkong, and was afterwards apprenticed as draughtsman to Messrs. Fenwick & Co. for nine years. He was then for nearly two years engineer to Messrs. Marty & Co., until, in 1895, he joined Messrs. Tung Tai Tseung Kee & Co. as manager. In this position he remained for ten years, when he purchased the business.



# THE MITSU BISHI DOCKYARD AND WORKS AT KOBE

The Mitsu-Bishi Dockyard and Engine Works at Wada Point, Kobe, were inaugurated on the 8th August, 1905, as another advance by the Mitsu-Bishi Company in their enterprise of Shipbuilding and Engineering. Prior to

and provide room for further extensions. The sea frontage of the works is more than 5,000 ft. long, a part of which has been reserved for ship-building berths suitable for the simultaneous construction of seven vessels of over 500 ft. in length.

*Machine and Erecting Shops.*—28,000 sq. ft., 41 lathes: 15 ft. diameter by 25 ft. 6 in. between centres; 4 planing machines: 18 ft. horizontally by 21 ft. vertically; 12 drilling machines: radial arm, 7 ft.; 6 slotting machines: stroke 9 ft.;



GENERAL VIEW OF THE MITSU BISHI DOCKYARD & ENGINE WORKS AT KOBE

this date, important preparations for reclaiming the land, constructing a breakwater, and other work had been done. A floating dock of 7,000 tons lifting power, built at the Company's Nagasaki Works, was towed into the basin, and two years later the works stood as one of the most prosperous concerns in the Japanese Empire. To provide for the rapidly increasing business, and extension on a large scale became a matter of urgent necessity, and, before the second anniversary of the works, the keel blocks of a floating dock of 12,000 tons lifting capacity were laid down, and additional permanent steel buildings for workshops were in course of construction.

The No. 2 Floating Dock was launched in November, 1908, and on the 8th December the S. S. *Mishima Maru*, one of the new European Liners of the Nippon Yusen Kaisha Line, 8,600 tons gross, was the first vessel docked. The works are now fully equipped with the latest machine tools and appliances, powerful enough to construct vessels up to 10,000 gross tonnage.

The works, which are situated on the western shore of the harbour of Kobe, just northward of the Wada-Misaki Lighthouse at the entrance of the port, have been laid out on an extensive scale. They cover an area of about 82 acres,

To the north of the building berths is a basin having an area of about 14 acres, protected by a breakwater of masonry work 1,000 ft. long, leaving an opening for entrance from the north. This opening is naturally sheltered by the shore of Hyogo, which lies at a distance of little over half a mile.

Alongside the basin, a masonry quay wall was constructed for the purpose of mooring vessels under repair, or under equipment with new machinery. A 100-ton steel tripod sheerlegs, by Day, Summers & Co., Southampton, has been recently erected on the foundation laid on the quay wall. There are four strong mooring buoys outside the breakwater, forming a safe deep water anchorage, and, as the establishment is connected with the Wada branch line of the Imperial Government Railway, the works occupy a unique position in this harbour in regard to communication by land and sea.

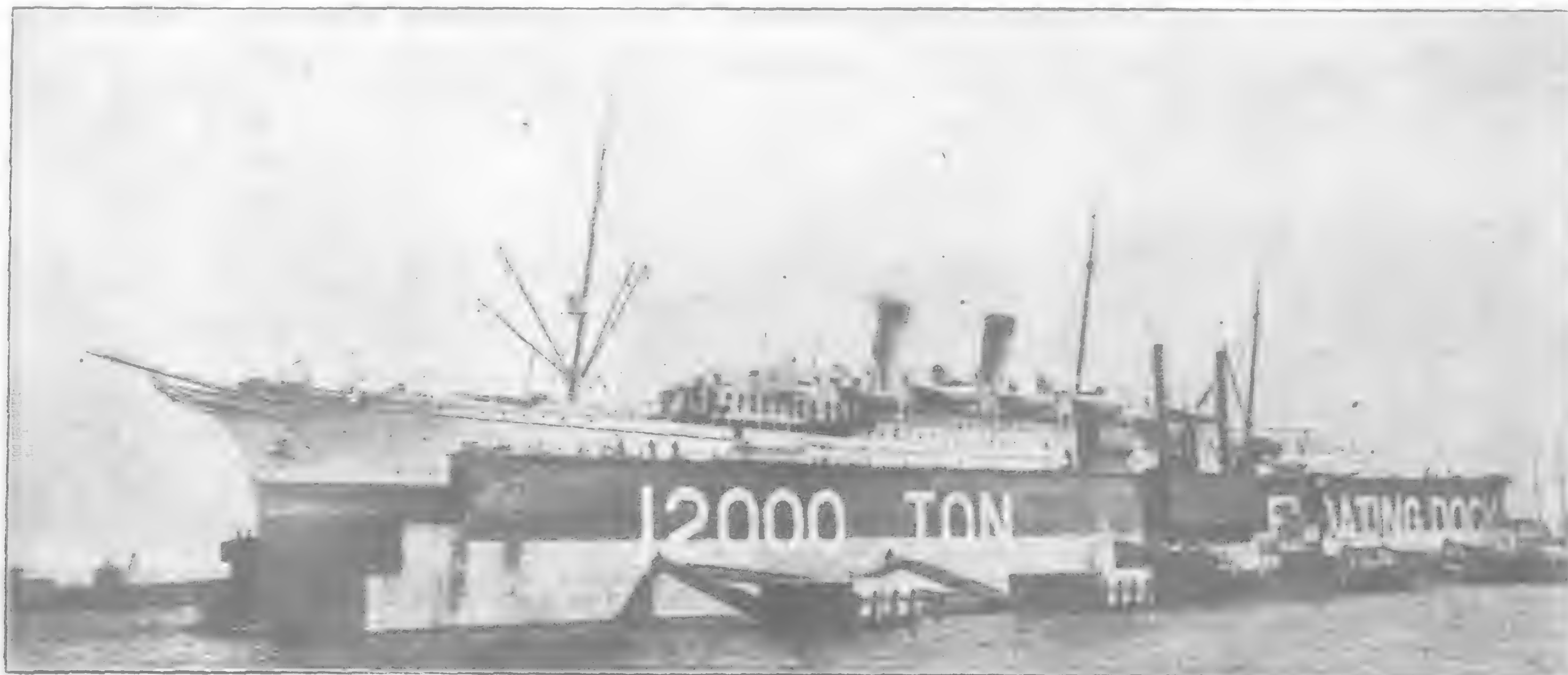
The following are the principal workshops, equipped with electric power and light, each connected by rails which are again connected with the Government railway lines. The dimensions given below against the various machine tools and machinery installed in the respective shops indicate their maximum capacities.:

6 shaping machines: stroke 2 ft.; 5 screwing machines: 4 in. diameter by 7 ft. long; 4 milling machines: 15 in. high by 7 ft. wide; 2 cold metal cutting machines, to cut 18 in. deep; 2 electric overhead travelling cranes, to lift 15 tons.

*Blacksmith Shop.*—15,900 sq. ft.—1,600 ton hydraulic forging press; 6 1-ton steam hammers; 1 gas furnace; 30 forges.

*Shipyard Machine Shops.*—22,250 sq. ft.—5 punching and shearing machines: to punch 1½ in. holes through 1½ in. thick, and shear 1½ in. thick; 1 beam and angle bending and shearing machine, for 14 in. beams; 2 planing machines: 28 ft. by 2 in. thick; 2 5-ft. radial drilling machines; 4 radial countersunk drilling machines; 1 set plate bending rollers, for plates 25 ft. long by 1½ in. thick; 1 set plate straightening rollers, for plates 6 ft. long by 1½ in. thick; 1 hydraulic keel plate bending machine, for plates 25 ft. long by 1½ in. thick; 1 hydraulic manhole punching and joggling machine, to punch holes 30 in. by 20 in.; 1 frame bevelling machine, for bevelling angles up to 7 in.; 1 portable pneumatic plant, for working pneumatic hammers, drills, etc.; 1 electric overhead travelling crane, to lift 3 tons.

*Boiler Shop.*—28,750 sq. ft.—6 drilling machines, for boilers 20 ft. diameter by 24 ft. long;

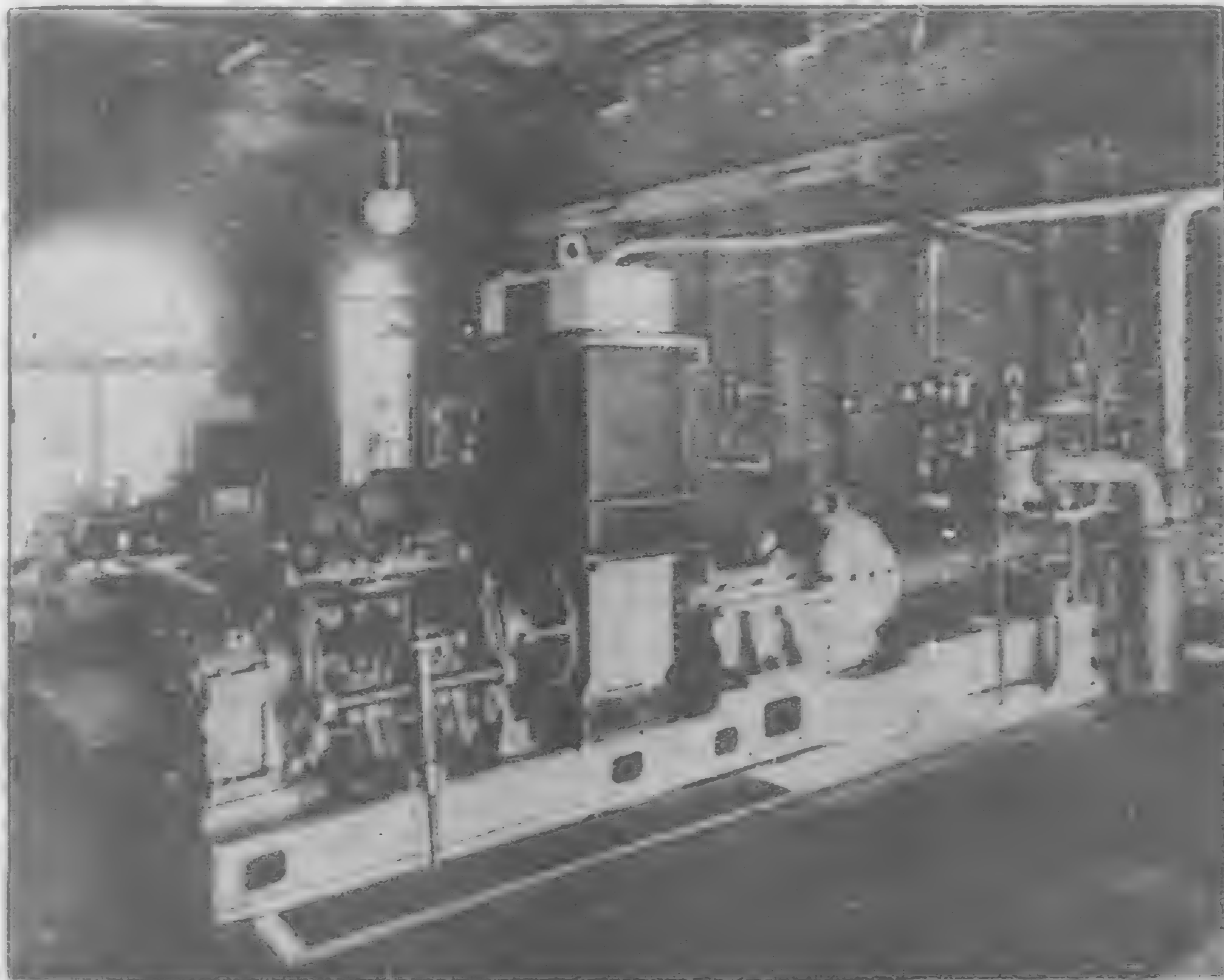


THE NO. 2 FLOATING DOCK OF THE MITSU BISHI CO. AT KOBE. LIFTING CAPACITY, 12,000 TONS. R. M. S. "EMPRESS OF CHINA" IN DOCK





NO. 2 POWER HOUSE AT THE KOBE WORKS OF THE MITSU BISHI CO.,  
450 B. H. P. COCKERILL TYPE GAS ENGINE



C. A. PARSONS PATENT TURBO-GENERATORS, MANUFACTURED UNDER  
LICENSE BY THE MITSU BISHI CO.



NO. 1 MACHINE SHOP, MITSU BISHI WORKS, KOBE



THE FOUNDRY OF THE MITSU BISHI WORKS AT KOBE



700-TON HYDRAULIC FORGE PRESS IN BLACKSMITH DEPARTMENT OF  
THE MITSU BISHI WORKS AT KOBE



100-TON STEEL TRIPOD SHEERLEGS LIFTING A BOILER FROM S. S. "TAICHU  
MARU" AT THE KOBE WORKS OF THE MITSU BISHI CO.





NO. 1 FLOATING DOCK OF THE MITSU BISHI CO. AT KOBE, 7000 TONS LIFTING CAPACITY



TWIN SCREW STEAM YACHT "MONIJI MARU" 100' X 20' X 10' DEPTH, BUILT BY THE MITSU BISHI WORKS AT KOBE

2 rollers, for bending plates 13 ft. by 2 in. thick; 1 punching and shearing machine, to punch  $1\frac{1}{2}$  in. holes through plates  $1\frac{1}{2}$  in. thick and shear plates  $1\frac{1}{2}$  in. thick; 3 hydraulic riveters, gap 13 ft. 6 in. and 160 tons pressure on rivet; 1 hydraulic plate flanging machine, 150 tons pressure on plate; 1 annealing furnace, 25 ft. by 18 ft.; 3 electric overhead travelling cranes, to lift 50 tons.

**Brass Foundry.**—120 ft. by 90 ft.—15 crucibles, capable of casting 5,000 lbs at single charge; 2 electric overhead travelling cranes, to lift 3 tons.

**Joiner and Carpenter Shops.**—10,875 sq. ft.

**Pattern Shop.**—100 ft. by 70 ft.

**Copper Smith Shop.**—165 ft. by 40 ft.

**Saw Mill.**—190 ft. by 35 ft.

**Bending Shop.**—50 ft. by 60 ft.

**Mould Loft.**—165 ft. by 50 ft.

**Iron Foundry.**—180 ft. by 120 ft.—4 cupolas, 10 tons per hour; 3 drying stoves, 27 ft. by 16 ft. by 15 ft.; 3 moulding pits, 20 ft. by 20 ft. by 18 ft.; 3 electric overhead travelling cranes, to lift 30 tons.

**Electrical Machinery Shops.**—16,800 sq. ft.—3 power presses, 3 ft. 7 in.; 3 notching presses, diameter, 40 in.; 2 field coil winding machines, 2 ft. 9 $\frac{1}{2}$  in.; 3 squaring shears, for squaring sheets up to 42 in.; 2 circular shearing machines, diameter 3 ft.; 4 milling machines, 36 in. by 9

in. by 20 in.; 1 slotting machine, 8 in. stroke; 1 shaping machine, 28 in. stroke; 12 lathes: 12 in. centres; 3 drilling machines: 23 in.; 3 portable electric drills; 1 vacuum impregnating tank; diameter 4 ft. 6 in. by 8 ft.; 2 portable cranes and hoists, to lift 2 tons.

**Power Houses.**—Electricity is used for power and lighting purposes in the workshops and offices. There are two generators in No. 1 power house, one of 100 k. w. and one of 150 k. w. capacity, driven by C. A. Parsons' steam turbines. In No. 2 power house, there is a 450 B.H.P. "Cockerill" gas engine, driving 1-300 k. w. generator, built at the works. Gas is supplied by a "Mond" gas producer of 800 B.H.P. capacity, which also supplies gas to the furnace in the blacksmith shop.

**No. 1 Floating Dock.**—No. 1 Floating Dock, the first built in Japan, was constructed at the Company's Nagasaki Works. It is securely moored inside the basin, and the advantages are: First, a ship can be docked at any state of the tide. Secondly, docking can be done more easily and in a shorter time than in a granite dock, as paint dries more quickly. Thirdly, the dock itself is practically on the same level as the workshops, so greater facility is afforded for conveyance of materials to the ship. The dock is very popular, and for the five years and a half ending Feb. 7th, 1911, 352 vessels

were docked, of an aggregate tonnage of 838,889 tons.

The following are the particulars of the dock:—Type—sectional pontoon, designed by Messrs. Clark & Standfield, of London; length on blocks, 387 ft. 6 $\frac{1}{2}$  in.; length over all, 412 ft. 6 $\frac{1}{2}$  in.; breadth over pontoons, 85 ft.; breadth inside rollers, 60 ft.; maximum length of ship taken in, 460 ft.; maximum beam of ship taken in, 56 ft.; maximum draft of ship taken in, 22 ft.; lifting power, 7,000 tons; time occupied in pumping out, for lifting a ship of 7,000 tons gross, 2 $\frac{1}{2}$  hours.

**No. 2 Floating Dock.**—No. 2 Dock was built at this shipyard, mostly from materials made at the Imperial Steel Works, in Kyushu, Japan. It is moored in the basin alongside the No. 1 Dock. During 3 years ending the 7th Dec., 1910, 92 vessels were docked, aggregating 306,638 tons gross.

The particulars of the dock are as follows:—Type—sectional pontoon, designed by Messrs. Clark & Standfield, of London, same as for No. 1 Dock; length on blocks, 505 ft. 11-16 in.; length over all, 532 ft. 6 in.; breadth over pontoons, 100 ft. 11-16 in.; breadth inside rollers, 70 ft.; maximum length of ship taken in, 580 ft.; maximum beam of ship taken in, 66 ft.; maximum draft of ship taken in, 26 ft.; lifting power, 12,000 tons; time occupied in pumping out, for lifting a ship of 12,000 tons gross 4 hours.

**Manufactures.**—In addition to building and repairing vessels and their equipments, the works is adapted for making the following: land type boilers, engines, hoisting machines, dredgers, steel girders, steel buildings, pipes and pillars and various alloys. Electrical machinery with accessories is also manufactured and repaired. The works is one of the leading electrical factories in the country, its workmanship is of the highest class, and a bright future is promised for it.

**Floating Sheerlegs and Salvage Plant.**—Attached to the works is a floating sheerlegs, of 40 tons working load, built at the Nagasaki Works, and the salvage steamer *Arima Maru*, with powerful pumps of 2,000 tons capacity per hour, completes the equipment of the works.

**Pension and Savings Bank, Hospitals, etc.**—In connection with these works are similar benevolent institutions for the welfare and encouragement of employees as at the works at Nagasaki. Gold medals of honor were awarded to the works at the Tokyo Industrial Exposition, 1907, and the Nagoya Industrial 1910.



SALVAGE S. S. ARIMA MARU OF THE MITSU BISHI WORKS AT KOBE



# THE KAWASAKI DOCKYARD COMPANY, LTD.

The Company was organized with a capital of two million yen in October, 1896, in Kobe. The origin of the Company, however, can be traced as far back as the early part of the 70's, and it can be said to be the pioneer of the Japanese shipbuilding industry. With Messrs. Kojiro Matsukata (President) and Yoshitaro

Kawasaki (Vice President) at the head of the Board of Directors, the Company began to expand steadily year by year, and at present (December, 1910) it occupies more than 104 acres of ground in all, and 206 buildings for offices, workshops and godowns stand thereon. The ground area actually covered by the main works of the company in Kawasaki Cho, Kobe,

is 47 acres, which are occupied by 198 buildings of various sizes. The area of the Hiogo Branch is 25.6 acres, that of the Shanghai Branch 13 acres, that of the ice works in Hiroshima 1.3 acres and that of the Dairen Branch 13.1 acres, while there are 4.4 acres besides the foregoing occupied by the residences of the company's officers.



FRONTAGE OF THE KAWASAKI DOCKYARD AT KOBE



S. S. 'TACOMA MARU,' OF THE OSAKA SHOSEN KAISHA BUILT AND ENGINEED BY THE KAWASAKI DOCKYARD LTD.



ONE OF THREE TORPEDO BOATS BUILT FOR THE ROYAL SIAMESE NAVY BY THE KAWASAKI DOCKYARD LTD.





CARRIAGES FOR THE HIOGO ELECTRIC TRAMWAY CO., BUILT BY THE KAWASAKI DOCKYARD, LTD.

The Company had to increase its capital several times, and it amounted to ten million yen, divided in 200,000 shares, in November, 1906. The total paid-up capital at present is 6,400,000 yen and that of the reserve funds 1,510,000 yen

Kobe; Shanghai Branch (re-opening of which is under consideration), Pootung, Shanghai.

Ordinarilly the company has been carrying the business relating to the building and repairs of all kinds of ships and machinery, iron and bronze castings and repairs of all descriptions;

of machinery, tools, locomotives and rolling stock, rails, etc., for railways and electric tramways, bridge girders and spans, arms, weapons, power machinery and industrial and mining machinery of every description, and gas and water pipes. It also undertakes salvage operations and towing, ice manufacture and all kinds of building and construction works.

The Hiogo Branch was inaugurated in July, 1907, and the steel casting, sawyers' works, and the construction of railway locomotives, electric tram carriages, bridges and girders of all descriptions have been carried on there.

The Dairen Branch was opened in July, 1908. There is one graving dock of 381' 0" length, capable of accommodating a vessel up to 3,000 tons. Repairs to vessels trading to and from or in North China coasts are undertaken. The works have already received a good deal of orders for machinery for factories and other land purposes and are well patronized by the general public.

*Patent Rights.*—The company having purchased the following patent right, now possesses the sole right to make and sell them in Japanese Empire, and in China and Siam in some cases:

Curtis Marine Steam Turbine, Cantilever Framed Steamship, Schmidt's Superheater for Marine & Locomotive Uses, General Electric Co.'s Electric Locomotive equipment and fittings, Weir's Uniflux Condenser, Miyabara's Water Tube Boiler, Aetonia Process of Casting, Monel Metal (Agency).

*Dry Docks and Slipways.*—The Company owns two dry docks and two patent slipways, their respective dimensions being as given below:



KOTOHIRA MARU IN NO. 1 DOCK OF THE KAWASAKI DOCKYARD AT KOBE

At the present moment the Company has its offices as mentioned below:

Main Offices and Works, Higashi Kawasaki-cho; Kobe; Hiogo Branch, Higashi Shiriike, Hiogo, Kobe; Dairen Branch, Hama-cho, Dairen (Dalny); Ice Works, Hiroshima near

but it now undertakes the following works:

Construction, manufacture and repairs of battleships, cruisers, torpedo-boats, destroyers, submarine boats, merchant steamships, dredgers, trawlers and vessels of any description; steel, iron and bronze castings, boilers and all kinds

No. 1 Graving Dock (Kobe).—Extreme length 425' 0"; length on blocks, 377' 0"; width of entrance on top, 63' 6"; width of entrance at bottom, 51' 7"; water on blocks at spring tide 24' 6".





CENTER BAY MACHINE SHOP, KAWASAKI DOCKYARD LTD.

No. 2 Graving Dock (Dairen).—Length, 381' 1"; width of entrance on top, 49' 2"; width of entrance at bottom, 48' 0"; depth over sill, 23' 3".

No. 3 Patent Slipway.—Length, 280' 0".

No. 4 Patent Slipway.—Length, 180' 0".

*Shipbuilding Stocks.*—The shipbuilding stocks at present are as follows:

No. 1 for vessels up to 4,000 tons (gross and displacement).

No. 2 for vessels up to 6,000 tons (gross and displacement).

No. 3 for vessels up to 20,000 tons (gross and displacement).

No. 4 for vessels up to 30,000 tons (gross and displacement). To be fitted with gantry crane shortly.

No. 5 for vessels up to 3,000 tons (gross and displacement).

The stocks are equipped with nine 3-ton and seven 8-ton derrick posts with electric winches. Besides the foregoing stocks several temporary stocks for vessels of smaller descriptions are available.

*Transport Service.*—There are 4 miles of railway tracks in the Main Works alone, to facilitate the conveyance of materials, and three locomotive cranes of 3-5 ton lifting capacity, besides two portable hand cranes, are employed on the tracks. The railway in the Hiogo Branch is connected with the State Railway at Hiogo Station.

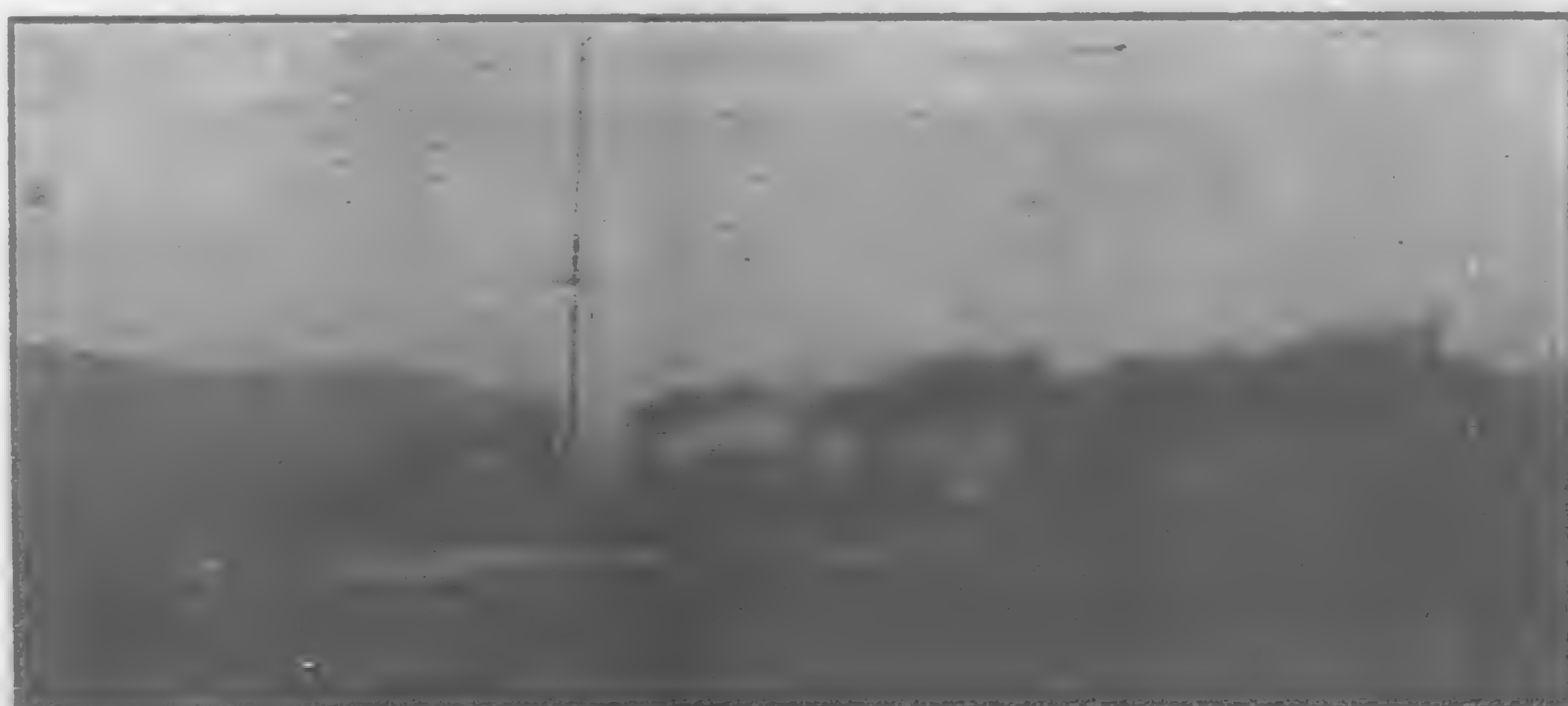


H. I. C. M.'S RIVER GUNBOAT "KIANG-YUAN"

Built at Kobe, 1905, by the Kawasaki Dockyard Company for the Viceroy of the Liang Kiang at Nanking. Displacement: 565 Tons; I. H. P., 487; Speed 14.8 on trial.—One 4.7 quick firing gun, one 3-in. and 3 3-pounders; 4 maxims.

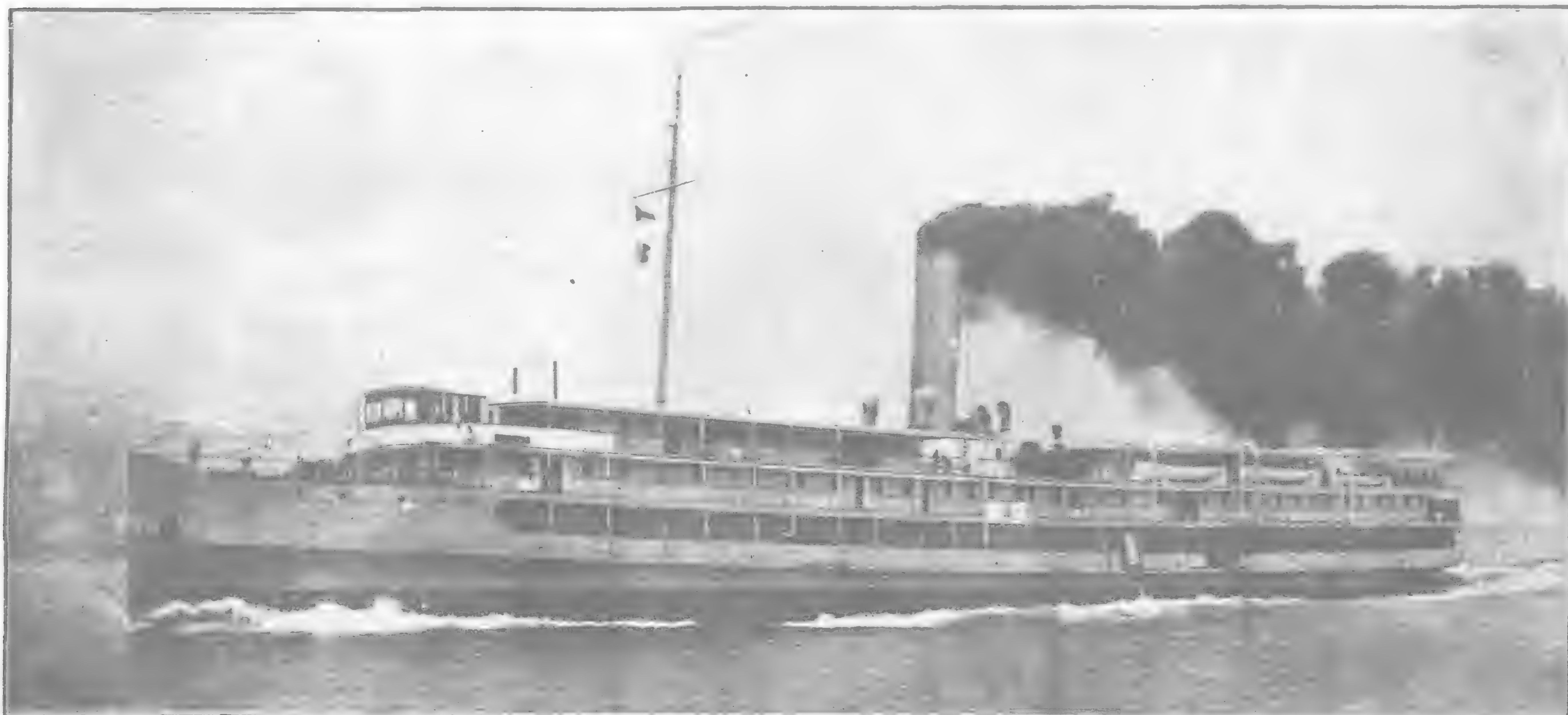


TRIAL TRIP OF H. I. J. M.'S TORPEDO-BOAT DESTROYER "ASAKAZE," 1905. SPEED 29.67 KNOTS. ONE OF FIVE SISTER SHIPS BUILT AND ENGINEED BY THE KAWASAKI DOCKYARD COMPANY, LTD.

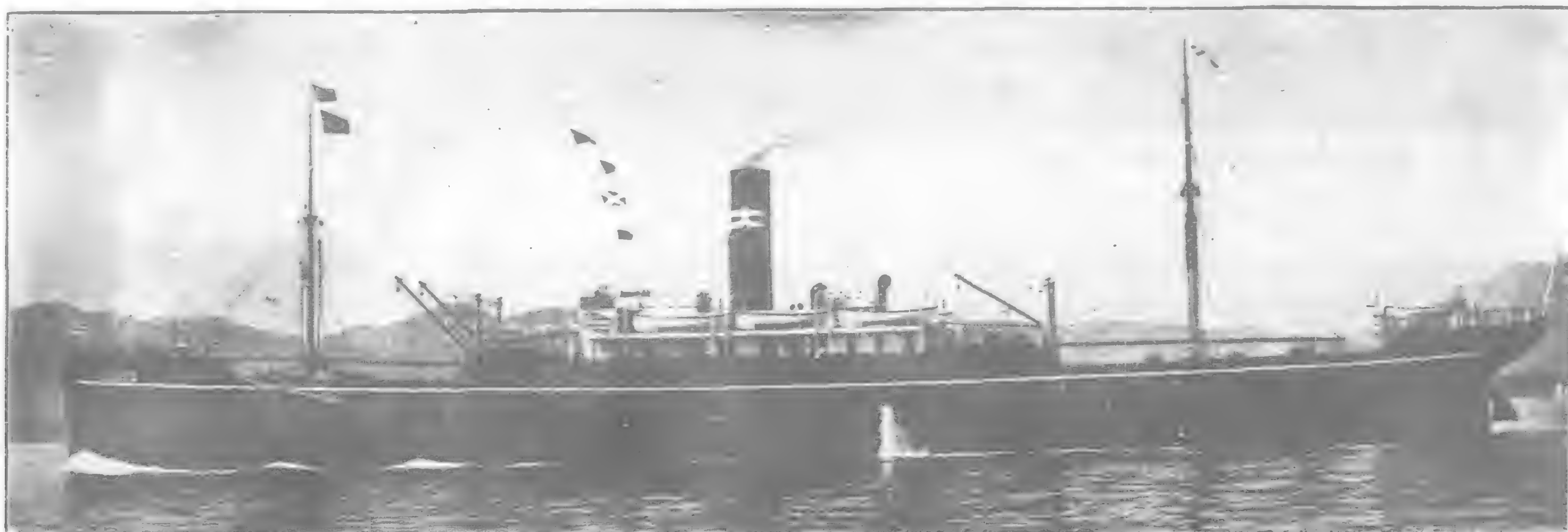


TRIAL TRIP OF H. I. J. M.'S TORPEDO-BOAT DESTROYER "ASAKAZE," 1905. SPEED 29.67 KNOTS. ONE OF FIVE SISTER SHIPS BUILT AND ENGINEED BY THE KAWASAKI DOCKYARD COMPANY, LTD.





THE NANYANG MARU OF THE NISSHEN KISEN KAISHA'S YANGTSE RIVER SERVICE, 3500 TONS GROSS: BUILT AND ENGINEED BY KAWASAKI DOCKYARD LTD.



THE SEATTLE MARU (6000 TONS GROSS) BUILT AND ENGINEED BY KAWASAKI DOCKYARD LTD. FOR THE OSAKA SHOSEN KAISHA



R. SIAMESE M. DESTROYER (375 TONS) BUILT AND ENGINEED BY KAWASAKI DOCKYARD LTD.



H. I. J. M. S. "YODO": BUILT AND ENGINEED BY KAWASAKI DOCKYARD LTD.





THE NIPPON YUSEN KAISHA S. S. MISHIMA MARU, 8500 TONS GROSS, BUILT AND ENGINED BY THE KAWASAKI DOCKYARD LD.

On the water there are two floating cranes, the capacity of one, which is the largest of the kind in the Far East, being 200 tons and that of the other 20 tons. There are also two wharf cranes and a sheer legs, which is capable of lifting 60 tons.

*Work-Shops.*—The work-shops, both in the hull and engine departments, are supplied in every respect with the most up-to-date machinery. The number of machines in use at the present time has reached the surprising total of 1,330.

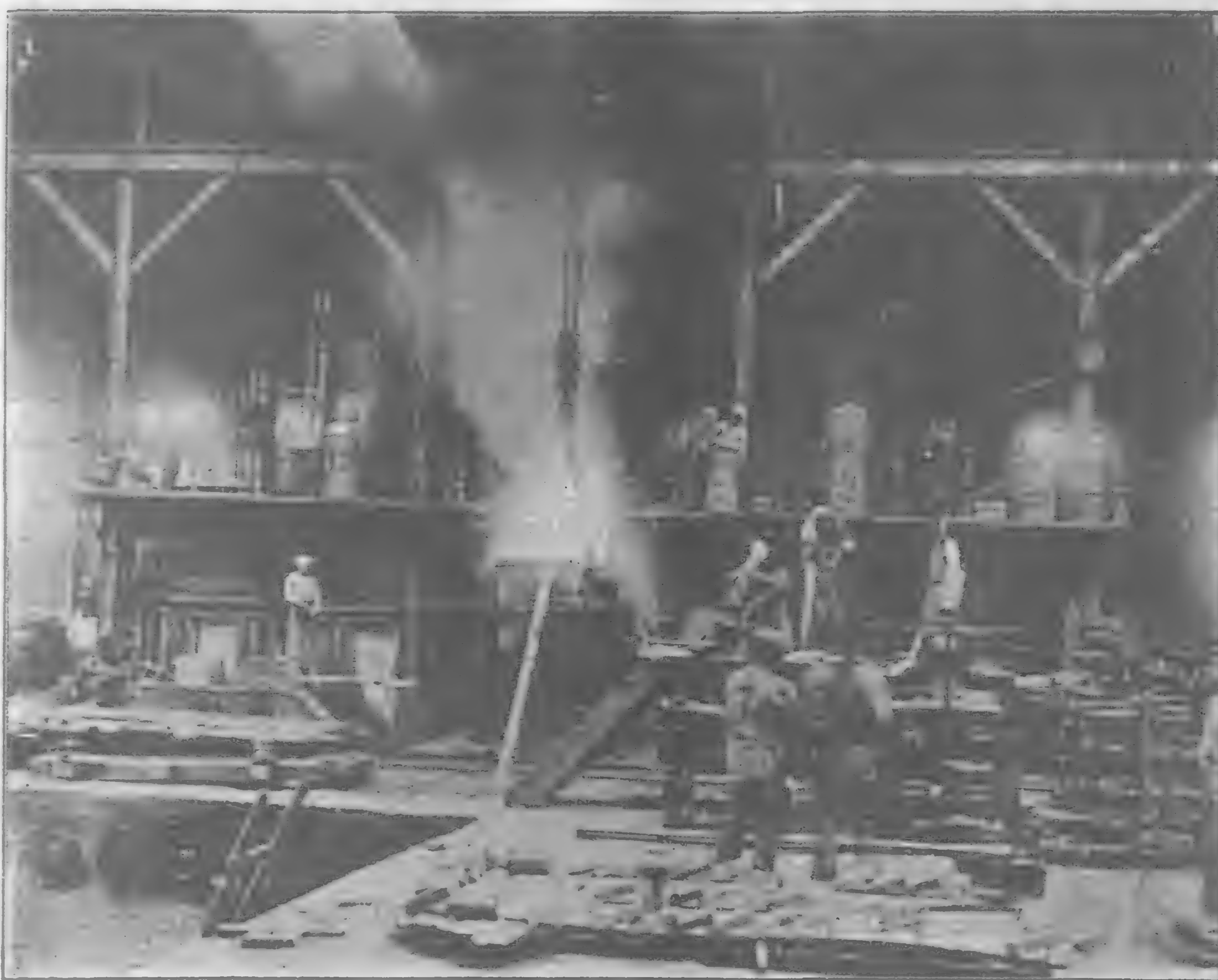
The largest diameter that can be turned on a lathe is 20 feet. The largest vertical planer can plane 16 feet horizontal and 13 feet vertical surface and the longest horizontal planer 24 feet by 8 feet by 6 feet. The largest shaft that can be turned is 80 feet long.

By means of electrically driven portable machine tools, every different part of a piece up to 30 feet by 30 feet can be worked at one time. The maximum over-head travelling crane capacity is 125 tons. The largest steel ingot, which can be cast in one charge is 15 tons.

*Company's Privilege.*—It was the Company's exclusive good fortune to receive orders for warships and machinery from foreign Governments in addition to orders from the Imperial Japanese Government. This fact alone suffices to encourage the Company to do its best in turning out the very best articles and so maintaining the honor which it has so far monopolized, thereby expressing its gratitude for the patronage bestowed on it. Several officers of the Company were decorated by the Japanese Government and foreign Governments in recognition of valuable services rendered.

*Principal Output and Works in Hand.*—The total number of vessels of all descriptions built and engined by the Company up to the present is 342 and that of engines and boilers, etc., is 2,381, besides 12 railway locomotives and 114 electric tram and railway carriages and a large quantity of bridge girders, gas and water pipes, etc.

The Company is building at present moment one cruiser, one gun-boat, one destroyer and one submarine boat; of these the cruiser and destroyer are to be equipped with turbine engines; two steamships of 6,200 tons and 3,000 tons respectively; six steam trawlers and two sets of turbine engines for a battleship and a cruiser, besides a large number of smaller vessels and various descriptions of machinery and railway rolling stock and other purposes.



MAIN STEEL FURNACE IN THE HIOGO BRANCH OF THE KAWASAKI DOCKYARD



H. I. C. M. GUNBOAT "CHU-TUNG," (750 TONS) BUILT AND ENGINED BY KAWASAKI DOCKYARD, LD.



# YOKOHAMA ENGINE & IRON WORKS, LTD.

The Yokohama Engine & Iron Works can justly be termed "The Pioneer Iron Works" of Japan. The works were first started in the year 1870 to meet the demand for repair work in ships and steamers, and local work offering. Yokohama was only a small place in those days, and the number and size of ships arriving in the port was very small compared with the present day. Moreover there were no railways or factories, so that their scope was limited. However, as the port grew in importance the local iron works, always kept pace with the times. In 1887 the business was purchased from Messrs. Whitfield & Dowson and Mr. Kildoye, the proprietors at that time, converted into a limited liability company, and registered with its present title under the Hong-kong Ordinance with a capital of Yen 130,000.

For many years after this the company enjoyed unique prosperity, earning handsome dividends for its shareholders, and gaining for itself a reputation for doing high class work in a prompt and most efficient manner.

In 1906 the company bought out a rival concern, the Peterson Engineering Company, which had come into existence in the meantime, the capital being increased to Yen 500,000 at which figure it now stands; the details being as follows:

Authorized capital, Yen 500,000; paid up capital, yen 390,000; reserve fund, yen 75,000; loans, yen 120,000.

It is expected that the balance of the unpaid capital (Yen 110,000) will shortly be offered solely to the present shareholders. It is entirely due to the conservative policy of the company in the past, in writing off liberally each year for depreciation, that the capital for such large and efficient works is as low as it stands at present. It is estimated that it

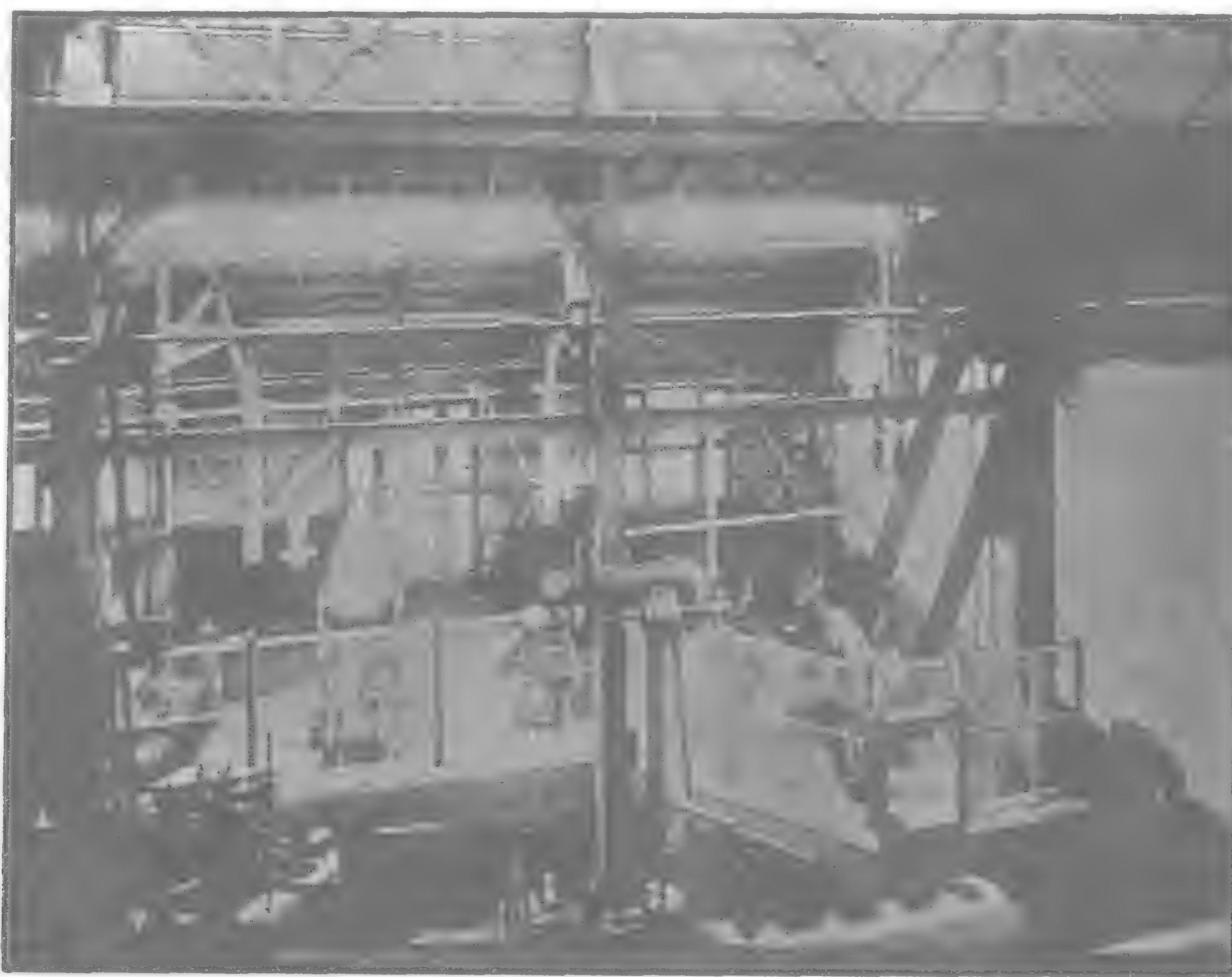


VIEW OF PORTION OF FITTING SHOP, LOOKING SOUTH, YOKOHAMA ENGINE & IRON WORKS

men are very cordial, labor troubles being non-existent.

Recently an import department was organ-

is agent for several important English manufacturers who appreciate the advantages of having their interests looked after by practical



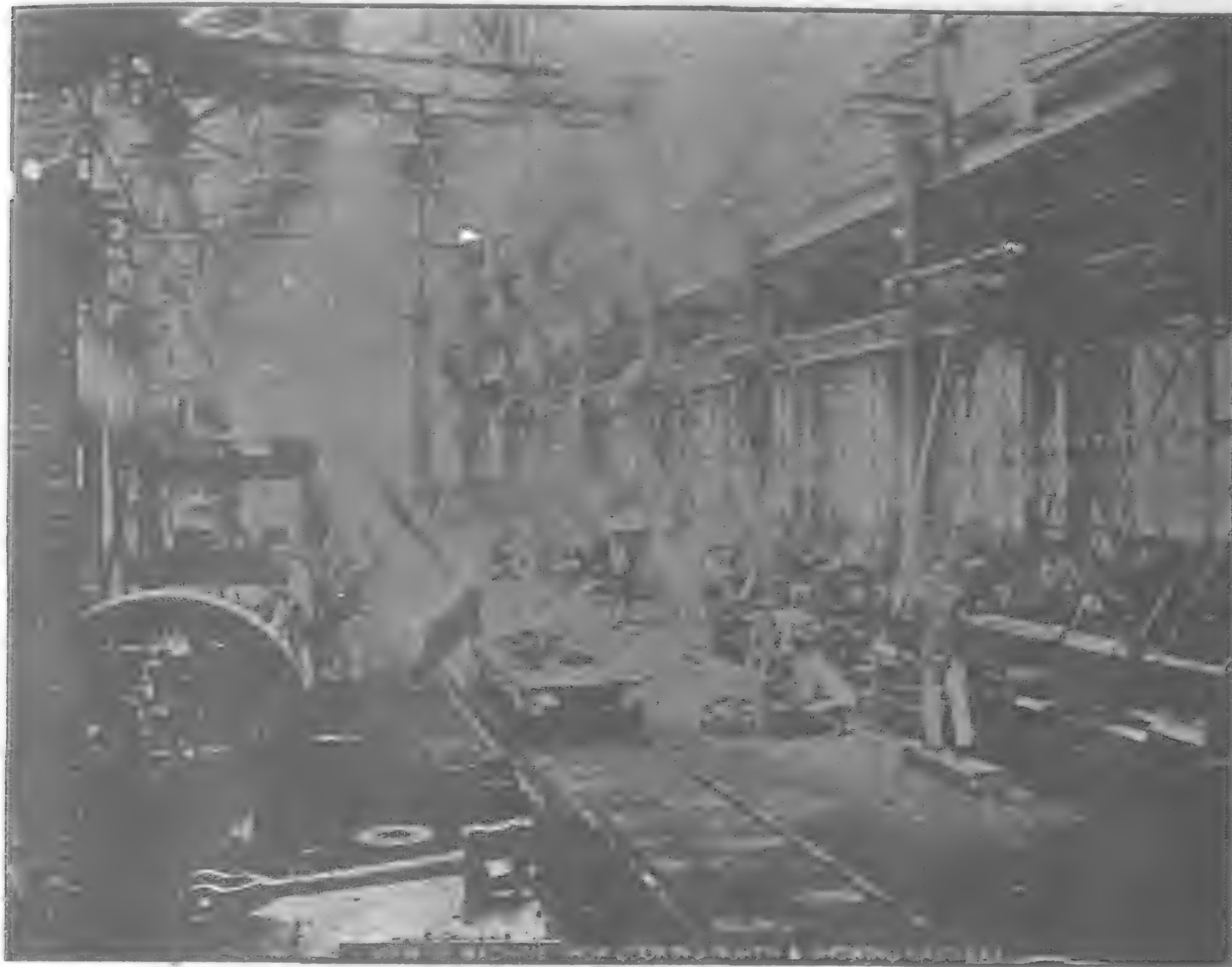
YOKOHAMA ENGINE & IRON WORKS

would cost double the company's present capital to duplicate the works. At the present moment the total number of men employed is about 500, and it is satisfactory to note that the relations between the management and the

ized, which, working in conjunction with the department devoted to manufacturing for the local requirements, enables the first to handle extensive contracts, including plant which still has to be manufactured abroad. The firm

engineers, with extensive work shops at their back, to attend to the small difficulties which of necessity arise when a contract is being executed so far away from the point of manufacture.





VIEW OF MACHINE SHOP LOOKING NORTH AND SHOWING EAST BAY, YOKOHAMA ENGINE AND IRON WORKS

The situation of the works in the Foreign Settlement, with its extensive water frontage, places the company in a most advantageous position to handle the shipping work of the port, to which for some time its attention was almost entirely devoted. In later years, however, manufacturing has been extensively undertaken and among its manufactures may be mentioned steam engines, boilers, pumps, iron

and steel chimneys, air compressors, small steamers and launches, railway appliances, railway freight cars, railway tank cars and a number of other lines too numerous to mention.

It may here be remarked that with its reputation for high quality work the company has enjoyed the patronage and confidence of foreign navies, notably that of the United States, for which a large amount of repair and manufac-

turing work has been executed, including gun mountings and new gun sights. The Rising Sun Petroleum Company placed contracts for large amounts, including 80 tank cars for use on the railway, and a quantity of iron buildings.

The Yokohama Engine & Iron Works, Ltd., are also approved manufacturers to the Japanese Navy and are frequently favored with contracts to manufacture various classes of machinery to Admiralty specifications. The Japanese naval inspectors have the reputation of being the most critical of any of the world's great naval powers and the fact that the products of the company are very favorably considered by them, is a high tribute to the quality of their productions.

Almost without exception have the manufactures of the company given the greatest satisfaction to buyers, as the rule of the company is to undertake high class work and not to take work at low competitive prices, which preclude the possibility of the high standard of work for which the company has earned such a just reputation.

The company in accordance with its avowed principle of keeping in line with the improvements in other parts of the world, not only has its management and engineering staff of Europeans but also employs European foremen for its various shops, who are recruited from time to time from the ranks of those who have gained experience in similar positions in the shops of the leading manufactures in the other side of the world. In this respect the company is unique in Japan; but the directors being firm believers in the axiom that "a satisfied customer is the best advertisement," act up to their opinion that this policy although an expensive one brings its reward in the long run.

The present works cover nearly 3 acres of ground and the plant has been kept thoroughly up-to-date. The recent extensions have been carried out to the designs of Mr. W. K. Tresizo, the works manager, and comprise a new machine shop 270 feet long by 70 feet wide, with a 15-ton travelling crane. Along the sides of this shop are arranged the numerous large lathes, drilling, planing, shaping, screw cutting and milling machines, while in the gallery are placed all the various smaller machines which go to making a complete plant. The foundry is adapted for castings up to 10 tons having 3 cupolas for iron and 5 furnaces for bronze castings, while latest types of cranes are used for handling heavy weights.

The boiler shops are equipped with modern machines, most of which are direct engine driven, the machines consisting of heavy plate bending rolls, multiple punching machines, punching and shearing machines, cold cutting machine saw, etc., etc., enabling the company to do the heaviest class of work. A powerful air compressing plant has been installed for use with pneumatic rivetting, chipping and caulking tools, the rivet forges being also kept going by compressed air.

The power plant consists of two 190 H. P. Babcock & Wilcox boilers, driving a large compound horizontal engine besides small engines, and these, with the electric lighting engine and compressor plant, are situated in the most convenient position to produce the utmost efficiency.

On the works grounds conveniently located between the plating shed and the machine shop is a small slip on which the company can repair or build vessels up to about 80 feet in length.

Realizing that increase of customs duties on manufactured machinery, which are to be enforced from July 17th of this year, must result in a large amount of plant which is now imported; being manufactured in Japan, they have made preparations to undertake the manufacture under royalty of machines and appliances on behalf of foreign manufacturers and inventors. Several firms have already concluded arrangements with the Yokohama Engine & Iron Works Ltd., with the intention of maintaining the trade they have previously enjoyed. It is confidently expected that many others will follow suit and that in this direction there will shortly be developed a large and increasing field for the company's operations.



VIEW OF MACHINE SHOP LOOKING NORTH AND SHOWING EAST BAY, YOKOHAMA ENGINE AND IRON WORKS





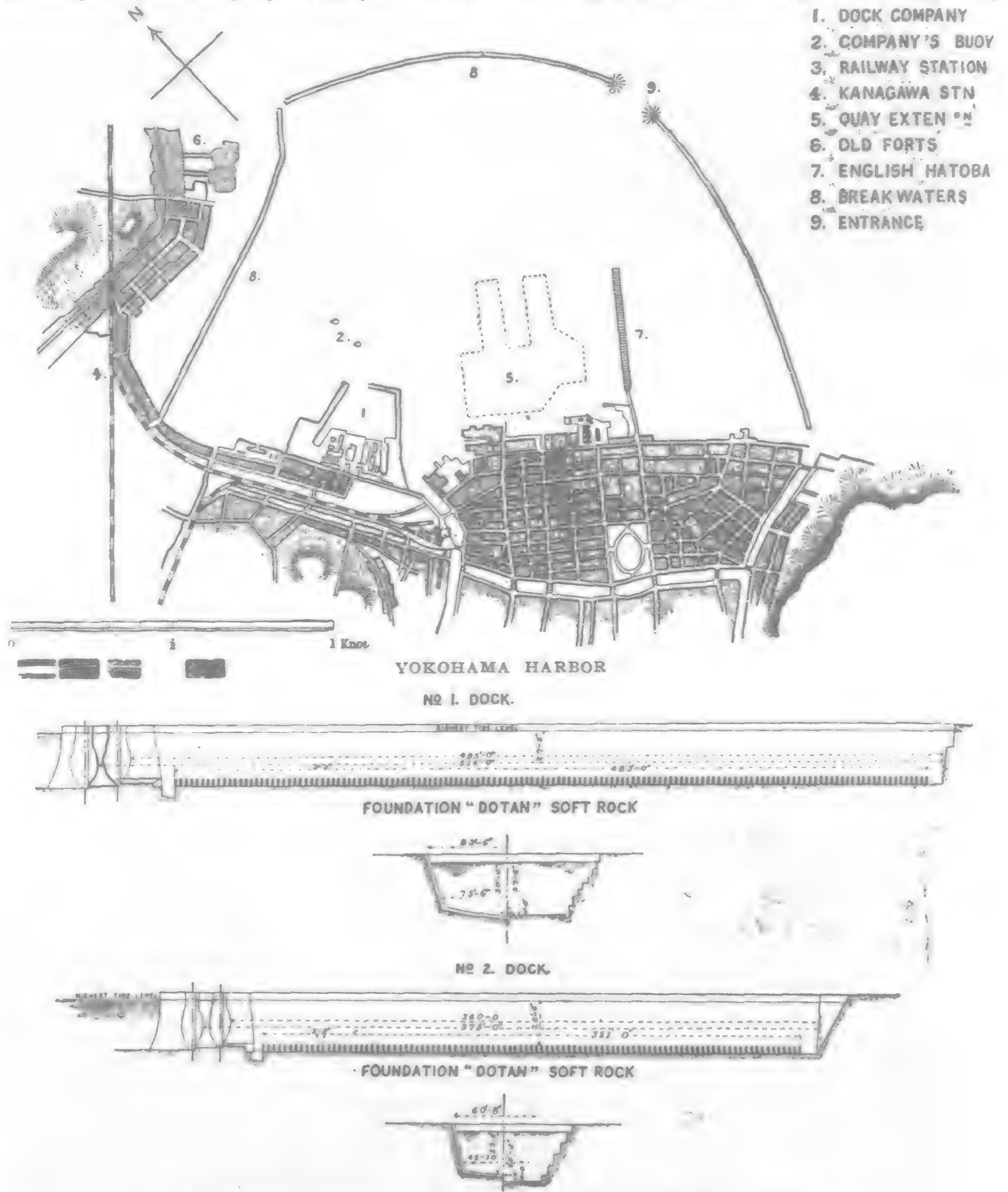
GENERAL VIEW OF YOKOHAMA DOCKS

### THE YOKOHAMA DOCK CO., LTD.

The necessity for dry docking facilities in the port of Yokohama began to be felt about the year 1887 on account of the great increase in the shipping business and the increasing number of vessels flying the Japanese flag and owned in Yokohama and Tokio. Previous to this date the Naval docks at Yokosuka, about eight miles from Yokohama, were available for merchant vessels, more or less by the courtesy of the Navy department. About the year 1887 a plan was formulated by Colonel Palmer, at the request of many influential gentlemen in Yokohama and Tokio and after much discussion and the lapse of several years, a company was formed in 1894 to take over the repair works of the Nippon Yusen Kaisha (Japan Steamship Company) and to build two dry docks. The position for the docks was carefully considered and an excellent site was obtained on very advantageous terms from the Central Government on the understanding that the company undertook to reclaim about 32 acres of the foreshore near the Yokohama railway station and build two

dry docks. The capital of the company was fixed at three million yen and a sum of Yen 1,980,000 was called up to build the docks and workshops of the company. The position of

the docks was well chosen within the harbor with a solid, though easily worked, rock foundation about 18 to 20 feet below high water level, making it quite unnecessary to have any heavy



PLAN SHOWING CONSTRUCTION OF YOKOHAMA DOCK COMPANY'S DOCKS



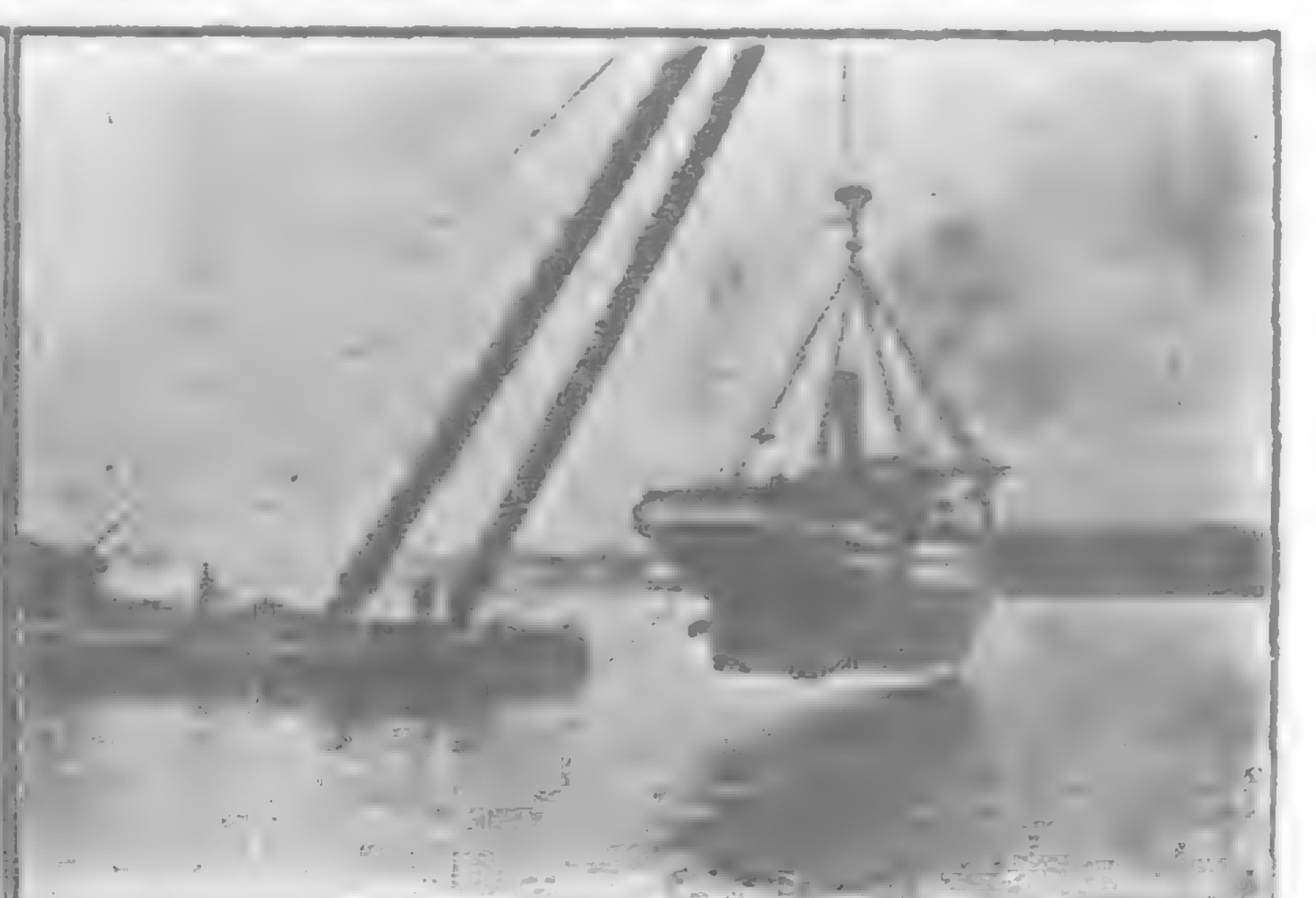
CENTRIFUGAL PUMPS FOR THE NEW DRY DOCK OF THE YOKOHAMA DOCK CO. LTD.



60-TON MOTOR BARGE

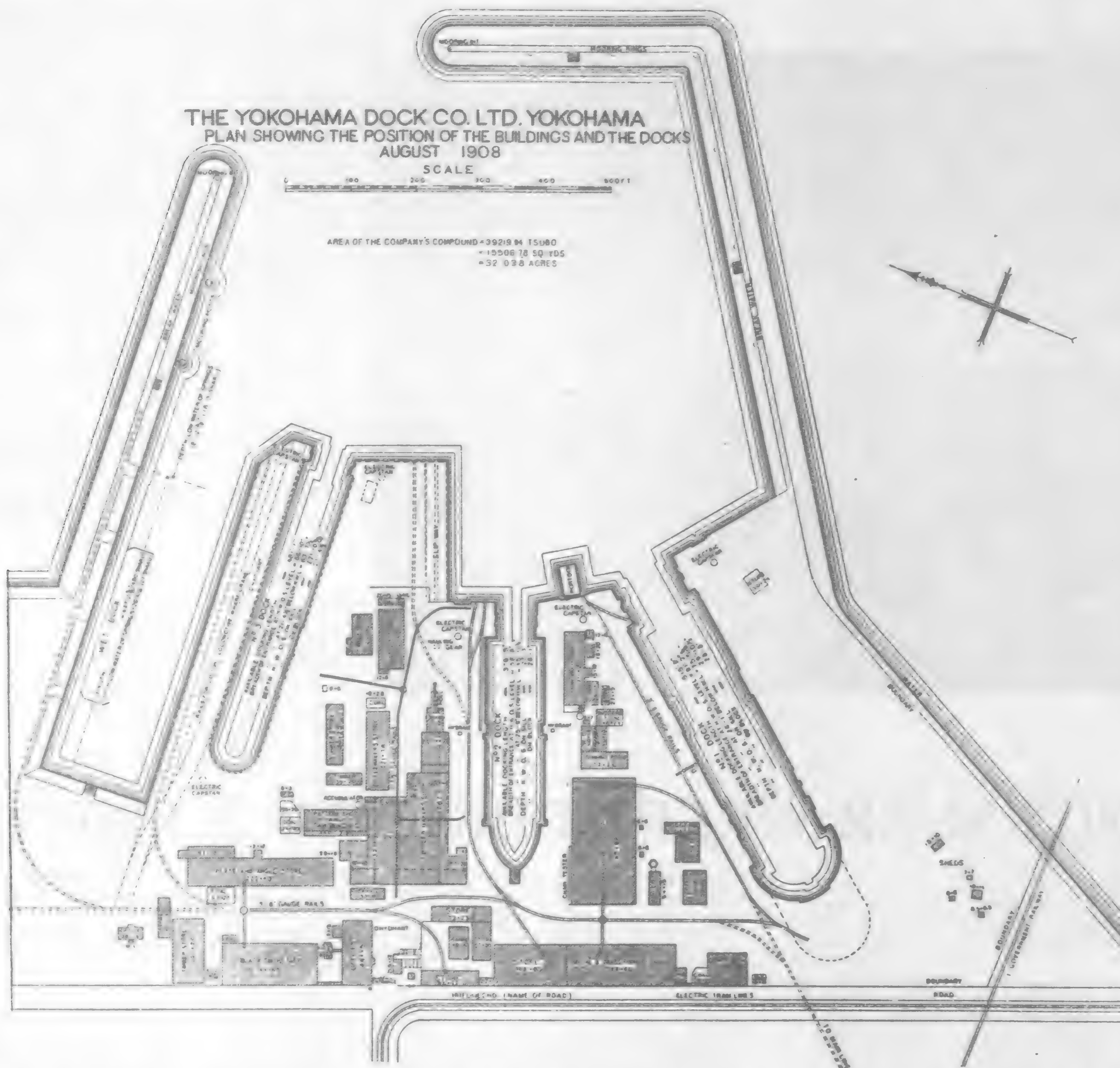


YOKOHAMA DOCK COMPANY. LAUNCH OF A 125-TON BARGE ON NEW SLIPWAY



SHEERLEGS LIFTING A 45-TON STEAM LAUNCH



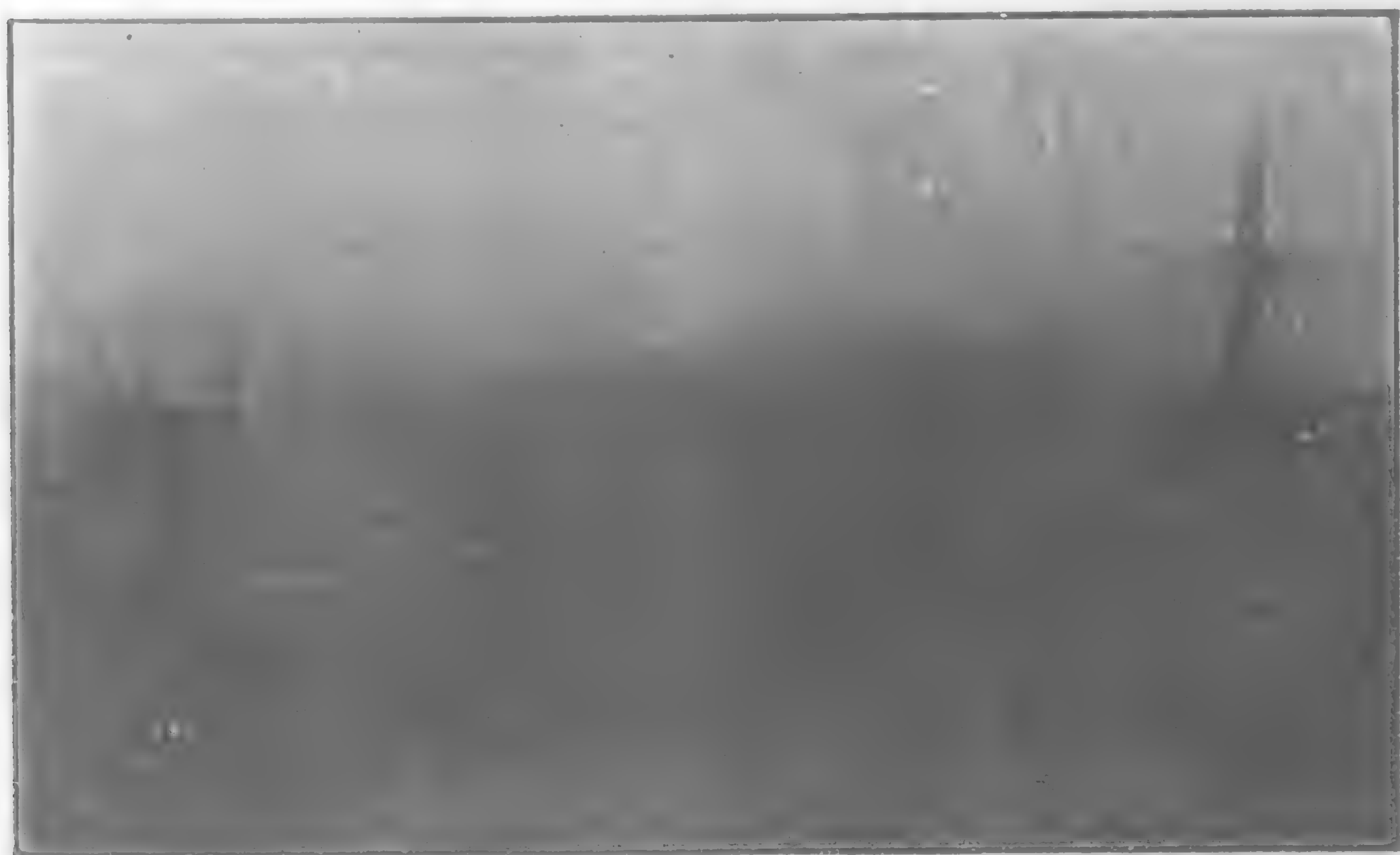


foundations. The two docks were built of hard granite obtained from the neighboring quarries of Idzu. Steel caissons were built for the entrances which can be worked at any state of the tide. The first dock was opened for business by the then President of the company, Baron Kawada, in April, 1897. It has a length, of 376 feet, a breadth at the entrance of 51 feet and a depth on the keel blocks of 26 feet at high water. The second dock was completed and opened in April 1899. It has a length of 584 feet, a breadth of 80 feet at the entrance,

and a depth over the keel blocks of 27 feet at high water. The water is pumped out of both docks by a duplicate set of centrifugal pumps made by W. H. Allen Son & Co. of Bedford.

The business of the company during the following years showed such a steady increase and improvement that it was deemed advisable in 1907 to commence the construction of a third dry dock and also a mooring basin to accommodate vessels repairing afloat. The size of the basin is 600 feet long and 180 feet wide and

the depth at low water is 27 feet. It is surrounded with concrete walls and was put into use in March 1909. The dry dock was built entirely of concrete of very ample thickness the working faces and entrance only being faced with granite. The available docking length is 485 feet, the width of the entrance 63 feet and the depth of water over the keel blocks is 21 feet. It was completed and put into use in November, 1910. The centrifugal pumping plant for emptying the dock was built by the company, the pumps being of the forced



YOKOHAMA DOCK COMPANY, LTD.—GENERAL VIEW OF WORKS AND DOCKS



YOKOHAMA DOCK COMPANY, LTD.—VIEW OF FIRST SHIP, SAIKIO MARU, ENTERING NO. 2 DOCK, 1897





GRANITE DRY DOCK OF THE KAWASAKI DOCKYARD CO., AT DAIREN

vortex pattern in duplicate, and are capable of drying the dock in 80 minutes.

It is the intention of the company in the near future to increase the length of the largest dock to about 620 feet to enable the larger vessels to be accommodated.

The three docks are served by 6 electric capstans placed in convenient positions for handling ships without their own steam.

Of the present directors of the company, Messrs. Kurusu chairman, Asada, Hara, Kondo, and Hutchinson, it is interesting to note that all except one were the original directors and promoters of the company.

In the year 1910 the business of the Yokohama Chino Soko (warehousing company) was acquired and amalgamated with that of the dock company. As the warehouses adjoin the companies mooring basin vessels are able to discharge their cargoes direct into the warehouses saving a considerable sum in lighterage in many cases.

Among the various trades carried on by the company are the following: Engineering in all branches, boilermaking, shiprepairing, constructional steel work, foundry work (castings up to 10 tons), coppersmithing, carpentering, electrical repairs, electroplating, sailmaking and rigging. The company is thus in a position to undertake the entire repairing of ships and their gear. A stock of certified tail shafts, rough turned, are kept to avoid detention as much as possible.

The tools and plant are well up to date. A large air compressor is installed with pipes along the bottom of the docks for pneumatic drills, and an oxy-acetylene plant for cutting and repairing boilers is now being installed.

The company are also owners of two powerful tow boats, six steam launches, and a floating derrick capable of lifting 45 tons over the rail of any steamer.

## TSINGTAUER WERFT TSINGTAU (KIAOCHAU)

The Tsingtauer Werft was established in 1900 and originally employed only a few hundred men. It was then operated under the name Marine-Werkstatt and executed smaller repairs of the German cruiser fleet in the far East. In 1905 a large floating dock of 16,000 tons lifting capacity was launched in Tsingtau, and moored in the new harbor, where at the same time a modern crane of 150 tons lifting capacity was built. In less than one and one-half years from unpretentious beginnings there gradually grew the present large concern, which employs now an average of 48 European and 1400 Chinese.

The general arrangement of the works may be seen from the accompanying plan, which shows the dock, the crane, the workshops, the coaling depot and the extensive system of railway connections.

In 1905 the large floating dock, which was built and constructed by the Gutehoffnungshutte, Oberhausen, Germany, was launched and put at once into service.

The dock measures 410 feet in length, 128 feet in breadth outside, 108 feet inside and 33 feet depth over keel blocks.

The dock's lifting capacity is 16,000 tons dead weight and it can accommodate vessels up to 460 feet in length. The dock is equipped



THE FLOATING DOCK OF THE TSINGTAUER WERFT AT TSINGTAU



STEAM TENDER BUILT AND ENGINEED BY THE TSINGTAUER WERFT

with 10 centrifugal pumps driven by electric motors. The five dock pontoons are divided into eight watertight compartments each. The valves for each compartment are closed and opened by motors mounted on shafts, which run up to the safety deck. Four windlasses, two five pumps and two 20 ton cranes at the ends of the dock are also operated by electricity. The lighting is electric and means are provided to supply the ships in dock with electric light, fresh water and steam heating. The dock is in every respect of modern design and construction and the width is large enough to allow increasing the length up to 660 feet, whenever the demands require it. The passage from the dock to the yard is provided for by means of a wide floating bridge.

The whole length of the quays is 3,600 feet and at the most convenient point near the





MACHINE SHOP OF THE TSINGTAUER WERFT

equipped with the newest electrically operated machine tools, constructed in Germany and America. The roof construction provides an ample supply of light in addition to the side and end windows. The center bay, where the heavy tools are located, is provided with a 20 tons travelling crane with a height of 22 feet above the floor. The side bays are used for smaller and medium size tools, for the store room and for the electricians' shop.

The boiler shop is 140 feet long and 70 feet wide and is also equipped with tools for working the largest pieces. The foundry is about 100 feet long and is equipped with two cupolas capable of producing cast iron for pieces up to 5 tons weight. A 5-ton travelling crane is running over the main bay. The brass foundry is in the same building and pieces up to one ton can be cast there.

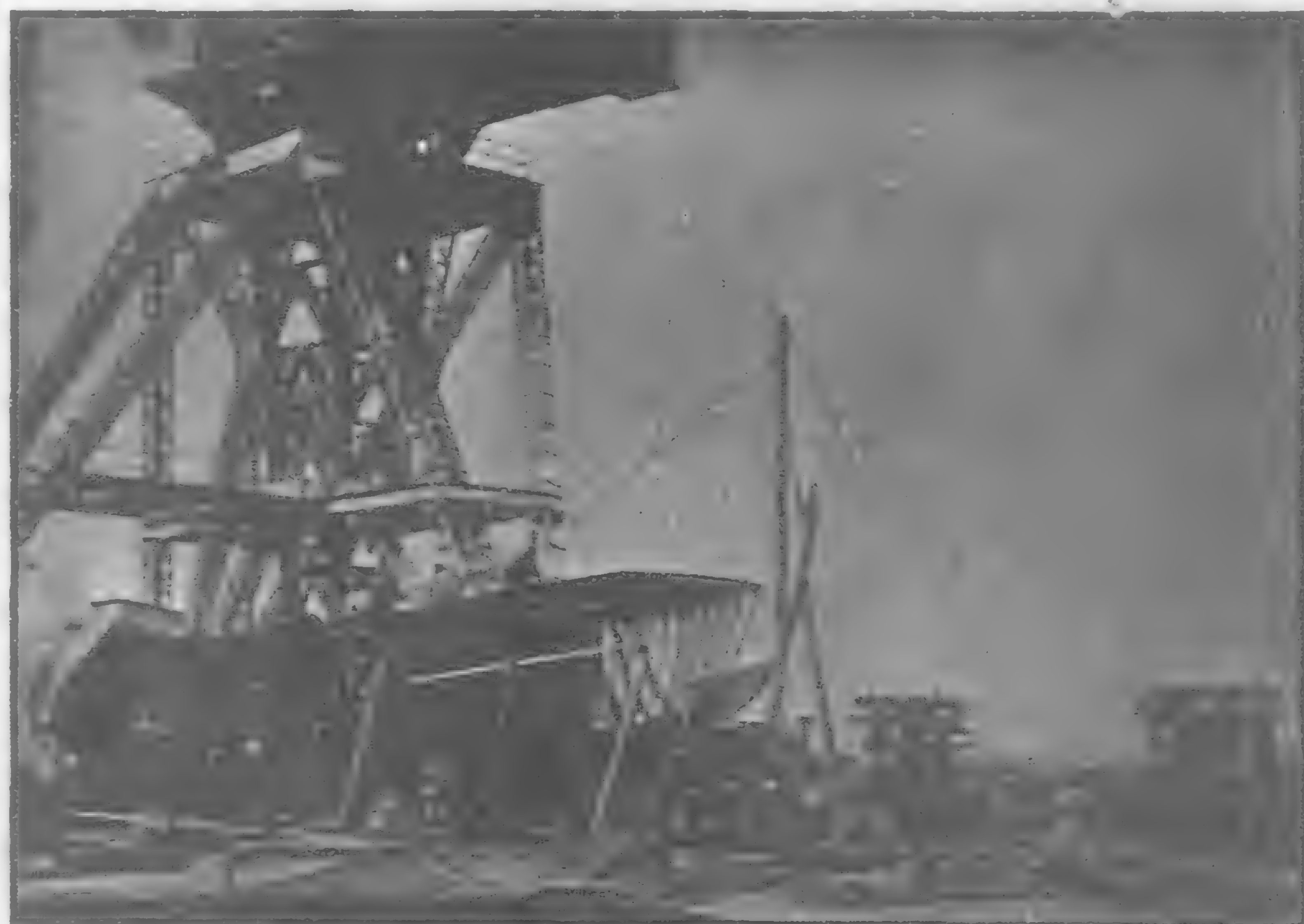
A large drying room is for drying the molds. Near to the foundry are located the pattern makers shop and the well arranged storage for patterns.

The forge and blacksmith shop is equipped with 4 electric hammers and 30 open fires for all kinds of blacksmith work. Outside of this building are the furnaces and the bending slabs for bending the frames for the vessels.

The shipbuilding shed and the place outside in front of it is devoted for punching machines, sheers, rolls, countersink machines, planers and drills of every description, and a floor for laying out steel construction.



THE 150 TON CRANE OF THE TSINGTAUER WERFT



150-TON CRANE OF THE TSINGTAUER WERFT

engine shop the 150 tons crane is erected. The crane is built by the well known German firm of Bechem & Keetmann in Duisburg. It has its own power station where the current from the city works is transformed into 500 volts.

The crane can lift 150 tons with the large tackle at a distance of 40 feet from the quay while with the small tackle 50 tons can be lifted at a distance of 80 feet from the quay.

The crane has often been tried to its utmost lifting capacity i. e. 150 tons. Vessels up to about 160 feet in length are built under the crane and launched at a minimum of cost, transferring them by the crane into the water. It has proved very convenient for lifting boilers, smokestacks, engines, guns, turrets and also steam launches on board of other vessels.

The general offices are situated in the center of the yard being within easy distance of the shops and the main storeroom.

Electricity is used throughout the whole yard for light and power. The current comes from the central station in the city. There are 3 power houses. One for operating the tools in the different shops and supplying electric light. The number of motors in the shops being 60. The second floor of the powerhouse is used for the large accumulator battery, which can supply light for 530 consecutive hours. Another power house is used for transforming the current for the dock motors. A third power house is used for transforming the current for the 150 tons crane.

The machine and erecting shop is 160 feet long and 110 feet wide with three bays and is



FOUNDRY OF THE TSINGTAUER WERFT





CABIN OF H. I. C. M. S. YACHT "WU FENG" BUILT AND ENGINED BY THE TSINGTAUER WERFT

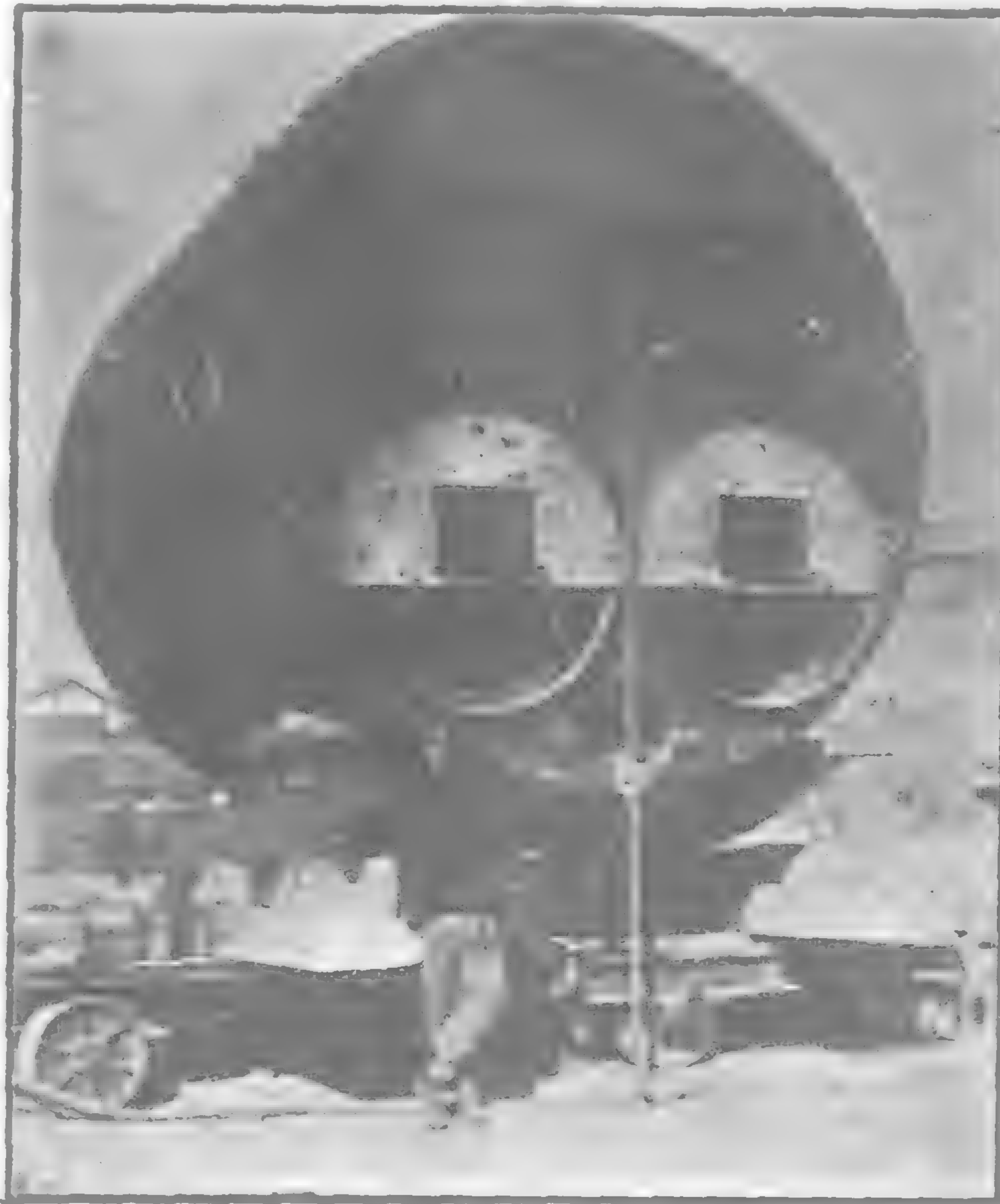
The joinershop is capable of producing the finest cabinet work and is connected with the paintshop and all kinds of upholstery can be done.

There are furthermore a sailmaker, boat-building, coppersmith shop and filecutting shop.

A special building is equipped with a plant for nickel plating, silverplating and gilding metal.

For transporting of materials and articles between the different shops a wide system of rails is laid out throughout the yard.

There are furthermore to be mentioned the boilerhouse from where steam is supplied for



MARINE BOILER BUILT AT THE TSINGTAUER WERFT

heating purposes for all buildings and for ships, while laying in dock or alongside the pier. Living quarters are provided for officers and men together with galleys and bathrooms, while ships are under repair. From the foregoing it will be understood that the works are equipped to do any kind of work as ships, engines, boilers and the various items of equipment and fittings including joinery, cabinet work and upholstery.

Up to the present time 16 ships have been built.

In the year of 1902 the yard started to put in every shop a certain number of Chinese boys as apprentices to the work, which number was increased every year. These boys had to learn for four years each their trade and proved to be very skilful. There are now working a number

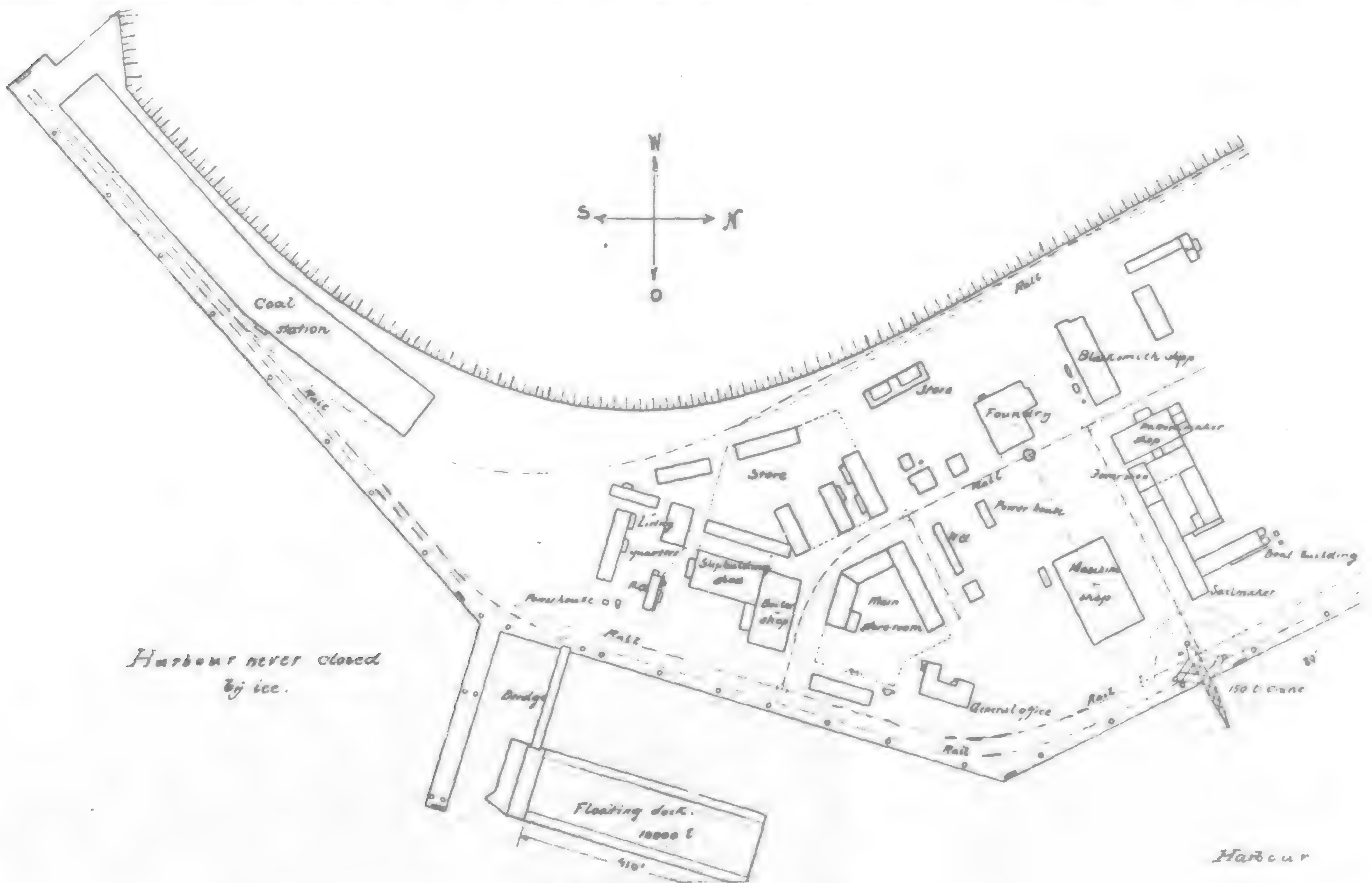


MARINE BOILER AND ENGINES BUILT BY THE TSINGTAUER WERFT

of about 400 Chinese, which form a staff of foremen or mechanics who have all been educated in the yard.

STEAM YACHT "WOO-FONG."—The steam yacht "Woo-Fong" was designed, built and engined by the Tsingtau Werft, Tsingtau, China, for order of the Imperial Chinese Navy Department and delivered in December last.

The vessel is built of steel with the following dimensions. Length between perpendiculars 126', beam 19', depth 10' with a displacement of about 220 tons. Externally she presents a striking picture. The lines of the hull



PLAN OF TSINGTAUER WERFT.



the graceful sheer and the tapering masts giving her a very handsome and yachtlike appearance. On the trials, which took place in the presence of Lieutenant Commander C. C. Wong of the Chinese navy, the yacht attained a speed of 15.1 knots on the measured mile in Kiautschou bay, thereby developing 600 indicated horse-powers. This is 1.1 knots in excess of the contract speed, which reflects great credit upon her builders. The vessel has five watertight bulkheads and a deck of selected teakwood and all deck fittings are of gun metal.

The forward deckhouse contains the dining room with sitting accommodation for 10 and is richly furnished with buffet, lockers, steam-heaters, etc., the ceiling being white enamel and gold.

In connection to the dining room there is a well equipped pantry and aft of this over the boilerroom is the galley situated. In the after-deckhouse are the accommodations for a private room for a Chinese prince, consisting of a combined sleeping and living room, a bathroom W. C., and toilet room. A private for a Chinese admiral is also situated in the after deck house. All these rooms are fitted luxuriously, the furniture, carpets, curtains, and all fittings as lamps, electric fans p.p. being supplied from Germany. Aft under deck there is a saloon and four state-rooms for the prince's suite, while forward under deck are the quarters for the crew with galley, lamp lockers and stores.

The yacht is fitted most completely with Lord Kelvin's standard compass, steam capstan



H. I. C. M.'S STEAM YACHT "WUFONG," BUILT AT THE TSINGTAU WORKS

and steam steering gear.

A complete electric lighting plant is installed for furnishing light and current for electric fans. A searchlight is also fitted on top of the forward deckhouse.

The top of both deckhouses is fitted as promenade decks with seats and awnings.

The machinery consists of two sets triple expansion engines of the usual vertical marine type. The cylinders, liners, covers, and sole plate are all of cast iron and the columns of polished steel. All the shafting is of forged steel. The propellers are three blade and of navy

bronze. The condenser is separate from main engines and with ample cooling surface. Three pumps are fitted to complete the pumping system of the yacht.

Steam at a pressure of 210 pounds is supplied by two water tube boilers. In the upper engine room there is situated a fan engine for producing the necessary draft for the boilers. The boiler room being operated on the closed stokehold system, when giving full speed.

The vessel, as can be seen from the accompanying pictures, is one of the prettiest craft, that has ever been seen in the Far East.

## \* THE KIANG-NAN DOCK AND ENGINEERING WORKS

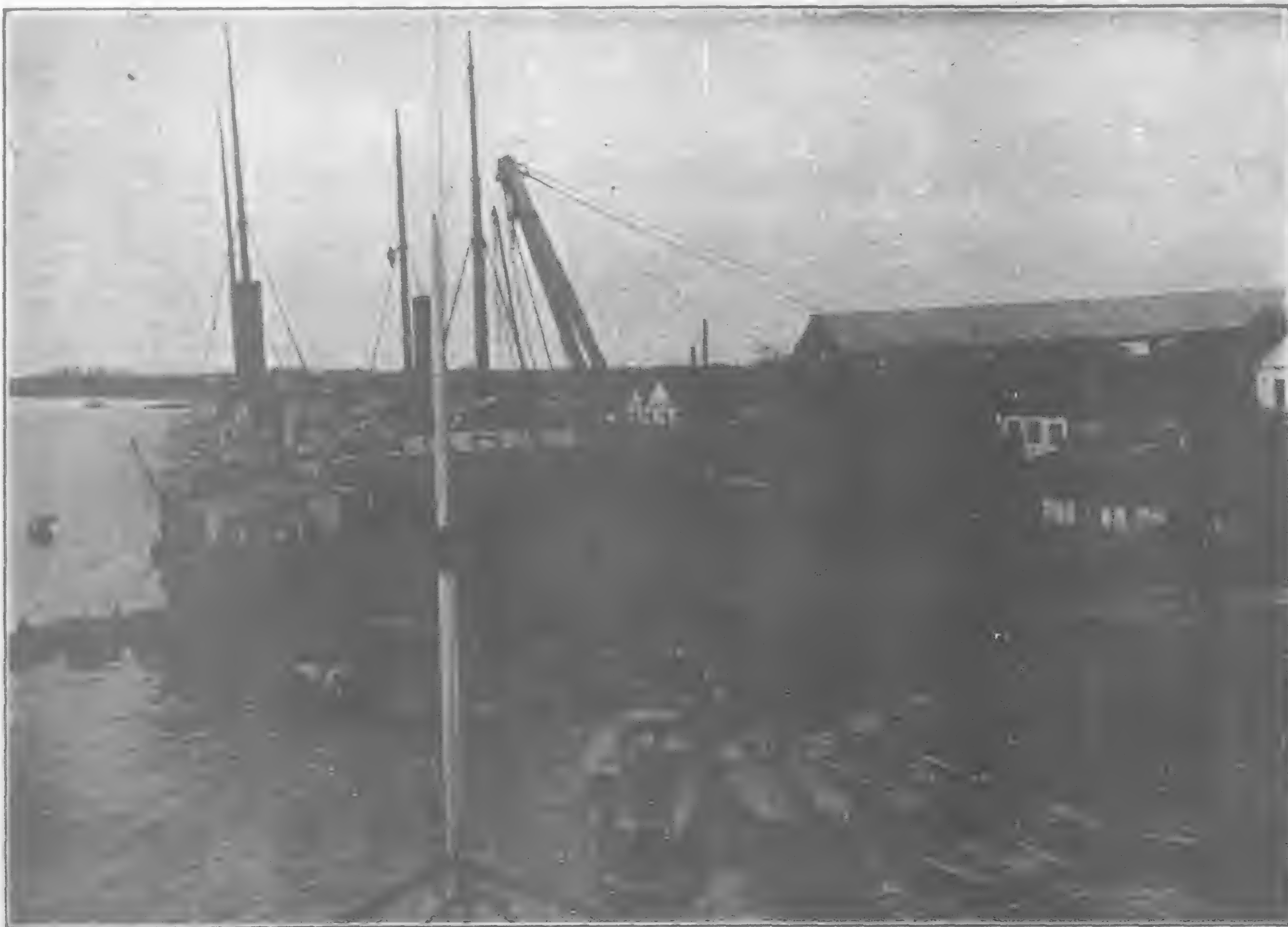
The Kiang-nan Dock and Engineering Works, one of the most enterprising and ably conducted concerns of its kind in the Far East, is situated on the left bank of the Whangpoo River, about four miles above the foreign settlements of Shanghai. The premises now occupied by the company

Reproduced from the Far Eastern Review of Feb. 1907.

originally formed part of the Imperial Chinese Government arsenal and dockyard at Kiang-nan, and is still contained within its walls, though the management and conduct of the business of the two establishments are now quite separate.

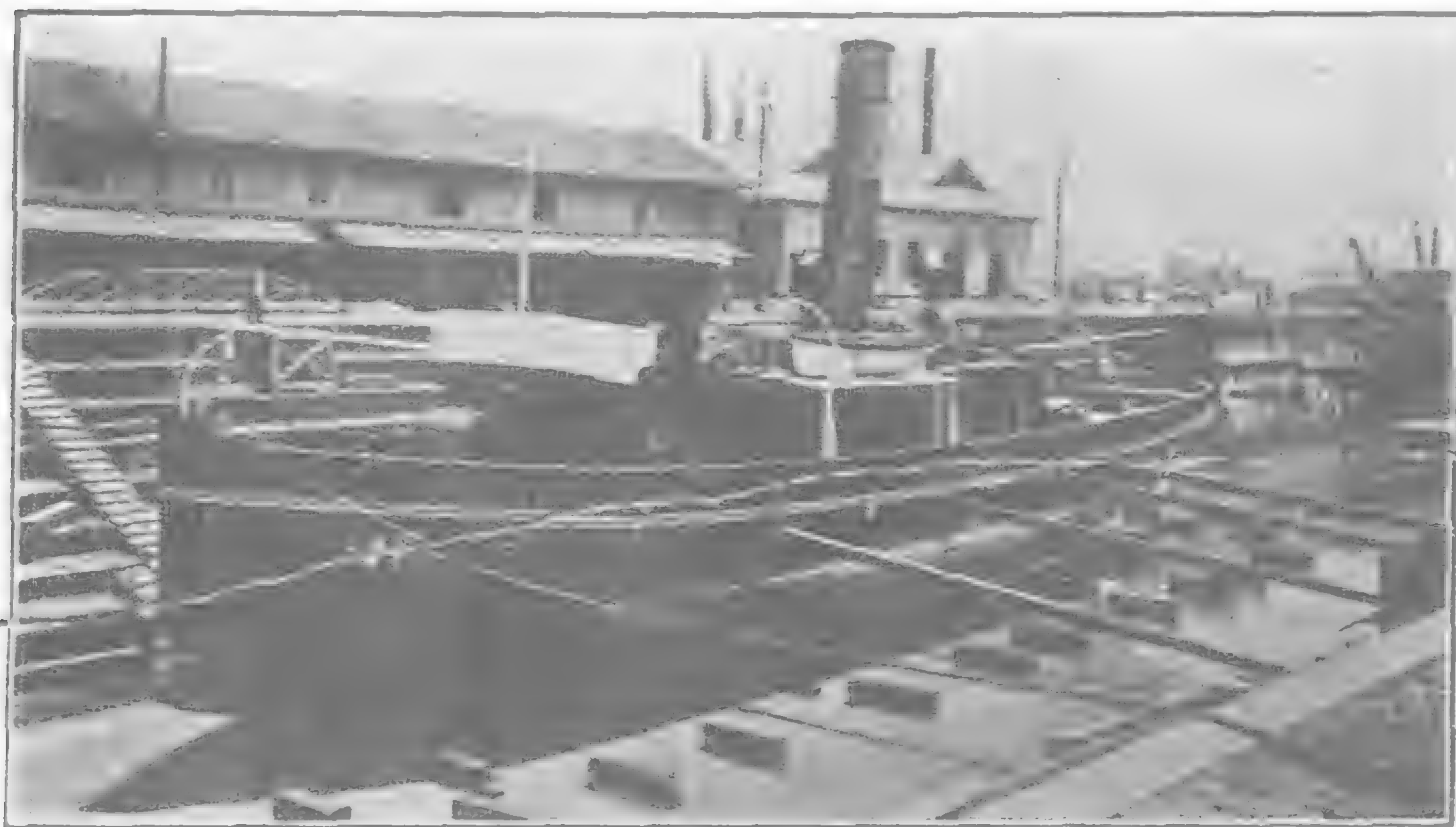
The arsenal and dockyard came into existence about forty-five years ago to meet the requirements of the Chinese Government for

the manufacture of cannon and the repair of the few small ships of war they at that time possessed, and has gradually grown to its present splendid proportions. In the spring of the year 1905 the dockyard portion of the arsenal, comprising an area of about four acres, lying between the steel works and gun factories on the one hand and the Whang-poo River on the other, was taken over by the present



WEST WHARF OF THE KIANGNAN DOCK AND ENGINEERING WORKS, SPANGHAI.





TWO VIEWS OF THE TSIN YUNG IN THE KIANGNAN DOCKS

company and launched as a going commercial concern, and they at once entered into keen competition with existing establishments of the same kind in Shanghai.

The directors of the Kiang-nan Dock and Engineering Works originally were Admiral C. P. Sah and Captain Y. K. Woo, both of the Imperial Chinese Navy, and Mr. L. Basse. The two latter gentlemen have since retired, and in their place Mr. Kwong-kwo-wah, the present incumbent, was installed as director.

Mr. R. B. Mauchan, a well-known and enterprising member of the engineering staff of Messrs. S. C. Farnham, Boyd, and Co., Limited, of Shanghai, was appointed manager, and still retains that position, assisted by an able staff, principally drawn from the same source. All these gentlemen were well known in the engineering world of the Far East, and to their enterprise and ability the rapid growth of the Kiang-nan Dock and



THE "KAN CHUEN," A STEEL SCREW WATER BOAT



H. I. C. M. S. "AN FOON," A STEEL SINGLE SCREW DISPATCH BOAT

Engineering Works may be mainly attributed.

*Dry Dock.* The dry dock, which was very small and totally inadequate for the purposes the company had in view when they took over the works, was the first thing that claimed attention, and steps were immediately taken to enlarge its capacity and to bring it in line with existing establishments of the same kind in Shanghai. Its length was increased to 375 ft. and its width at bottom to 80 ft. the whole of the bottom new piled and decked, and new keel-blocks installed throughout. The somewhat antiquated pumping machinery was wholly removed, and a new modern pumping plant installed, consisting of two 20-in. and one 10-in. centrifugal compound pumping engines. The pumping plant is contained in a large steel tank sunk about 12 ft. into the ground and resting on a huge concrete foundation. Steam is supplied by two large Lancashire boilers, arranged with separate flues and funnels, while an

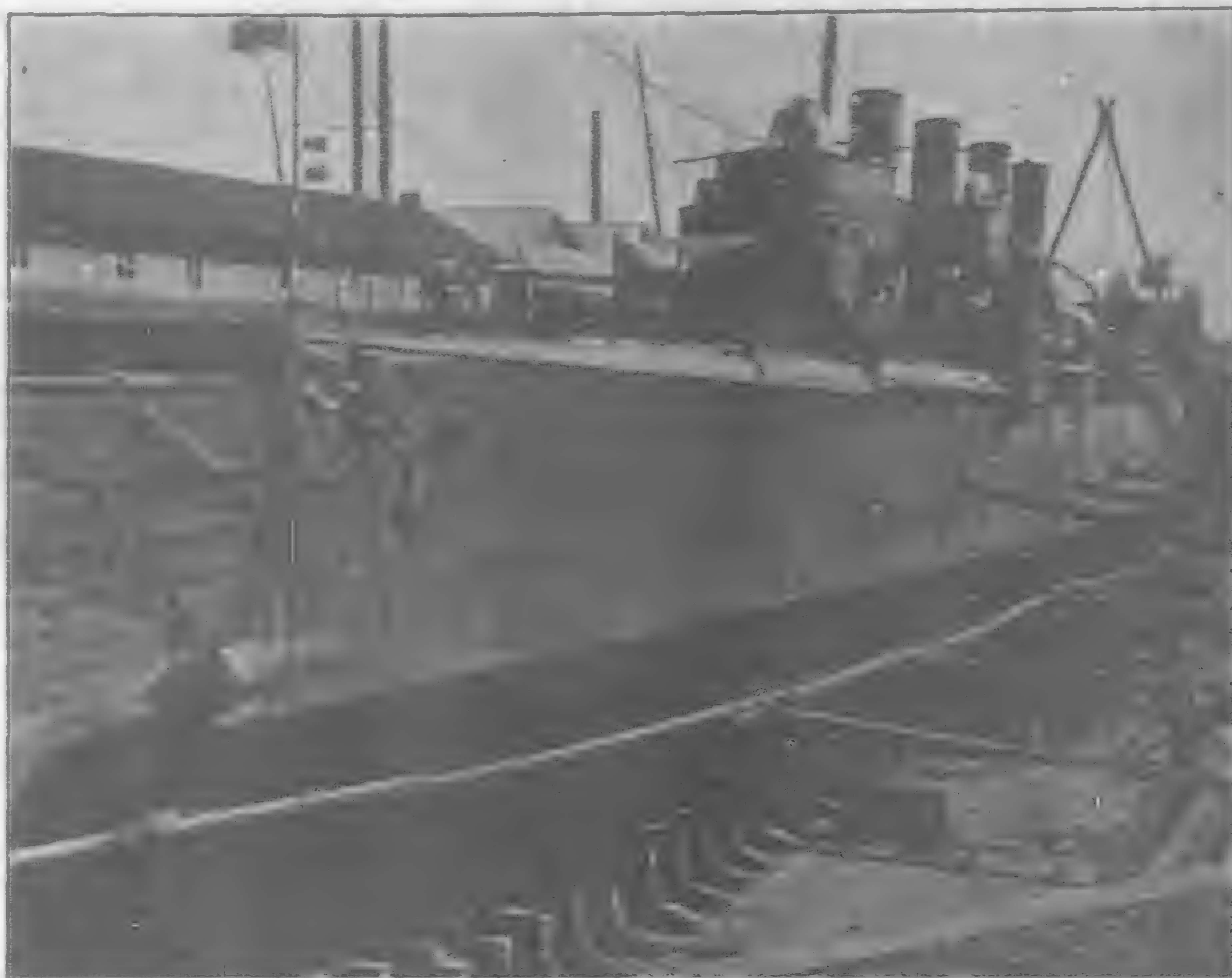


KIANGNAN DOCK—LENGTH OVER ALL, 385'; LENGTH ON BLOCKS, 375'; WATER ON SILL, 19'; DOCK ENTRANCE, TOP, 70', BOTTOM, 60'



auxiliary boiler of the marine type is fitted for use in case of emergency, all with a working pressure of 100 lbs. per square inch. A feedwater heater, with feed pumps of the Worthington type in duplicate, is supplied for feeding the boilers. The pump-house, though built primarily for housing the boilers and pumping machinery, also contains the dynamo engine room, with lavatory and bathrooms for the convenience of the crews of ships using the dock, dock tool store, etc. On either side of the dock entrance are wharves, alongside of which ships entering or leaving the dock or refitting can lie. Both these wharves have recently been extended about 40 ft. further into the river to get deeper water alongside, and a Priestman dredger is provided to remove any accumulation of silt that may occur there or at the dock entrance. On the upper wharf is fitted a heavy pair of sheer legs, capable of lifting 60 tons, with boiler and winding engine complete. In the river and abreast of the company's premises are three large mooring buoys for the accommodation of ships undergoing repair. On the opposite shore of the river is a deep-water anchorage, where the Chinese men-of-war in port usually lie.

*Boiler Shop.*—Passing up the west side of the dock and bearing to the left, one comes to the shipbuilding yard and slips, where tow-boats, launches, and other small craft are hauled up for repair. Near by is the boiler shop, with its punching, shearing, and plate-bending, plate-edge planing, and drilling



KIANGNAN DOCK WITH A CHINESE CRUISER ON THE WAYS



YANGTZE RIVER PIRATE CHASER, BUILT BY THE KIANGNAN DOCK & ENGINEERING WORKS FOR THE VICEROY OF NANKING

machines, plate furnace, and frame-bending floor, and the usual accessories of a modern boiler shop and shipyard. The machinery of this shop is driven by a large Tangye noncondensing engine, while alongside of it is another engine of similar dimensions, which is kept ready for immediate use in the event of anything happening to the former. Steam for these engines is supplied by two large Lancashire boilers at a pressure of 75 lbs. per square inch.

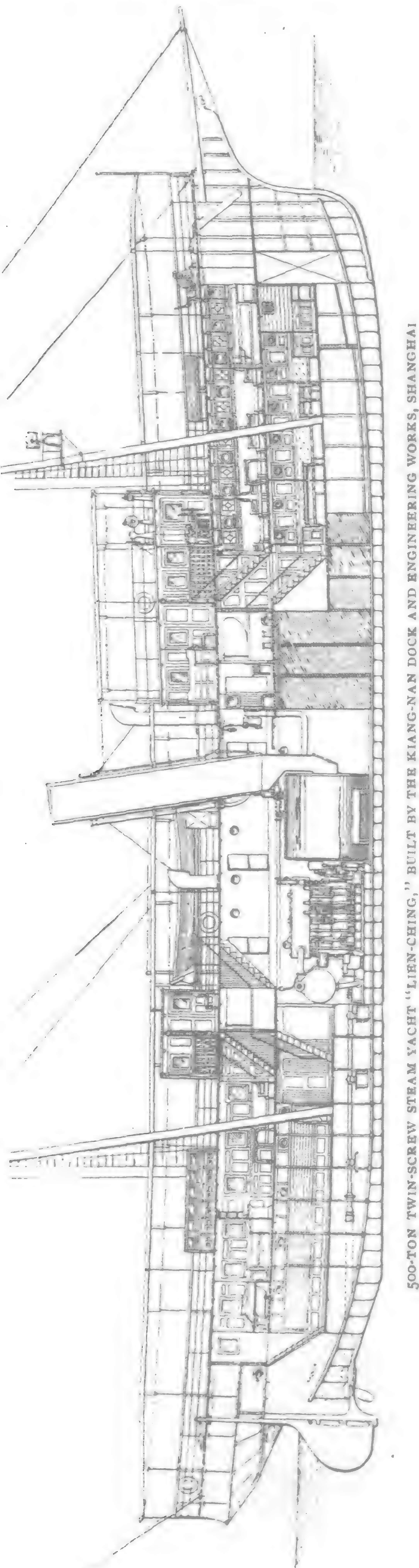
*Admiralty House Drawing and General Offices.*—Retracing one's steps and passing round the head of the dry dock, on the right is seen the mould loft, carpenters' shops, and a number of huge godowns used for the storage and seasoning of timber. On the left and standing back some distance from the roadway, with a fine stretch of lawn in front of it, stands Admiralty House, a large and handsome building recently erected, forming the residence of Admiral C. P. Sah, Commander-in-Chief of the Imperial Chinese Navy, and containing also the various offices in connection with his department. Nearly opposite this building are situated the company's offices, the ground floor of which is occupied by the directors, manager, and accountants, while the whole of the upper storey is devoted to the use of the drawing office staff.

*Machine Shop.*—Just over the way from here is the machine shop, a large and commodious new building, which is served by a 40-ton travelling crane, supported on cast-iron columns, with steel girders, and running the whole length of the shop. The heavy lathes, planing, and boring machines are placed on either side of the central aisle, where they can be easily and rapidly served by the travelling crane, while the two side bays are fitted with the smaller lathes and machines. On first entering this fine shop one's attention is immediately taken by a huge triple-gear face lathe, manufactured by Messrs. Craven Brothers, of Manchester, the chuck of which is capable of taking in a piece of work 10 ft. 6 ins. diameter by 3 ft. long. Next to this and in line with it is another heavy triple-gear sliding, surfacing, and screw-cutting lathe, also by Messrs. Craven Brothers, 25-in. centres, and capable of taking in a piece of work 32 ft. in length, which, with its



YACHT OF H. I. H. PRINCE HSUI, BUILT BY THE KIANGNAN DOCK & ENGINEERING WORKS





500-TON TWIN-SCREW STEAM YACHT "LIEN-CHING," BUILT BY THE KIANG-NAN DOCK AND ENGINEERING WORKS, SHANGHAI



POLICE BOAT FOR INLAND WATERS, BUILT BY THE KIANGNAN DOCK &amp; ENGINEERING WORKS FOR THE NANKING VICEROY

two double slide rests, carries four tools, all of which can be put in operation at the same time, rendering this a very valuable machine indeed. Next comes a heavy horizontal drilling and boring machine by Smith, Beacock, and Tannett, with two massive boring heads, each of which can be worked independently of the other, and capable of doing a large variety of work. Immediately adjoining this is a heavy vertical planing machine with horizontal traverse, which can take in and machine a piece of work 10 ft. 6 ins. by 16 ft. long. A large horizontal planing machine comes next, and several smaller machines. The other side of the shop under the crane is similarly fitted with heavy machines, among which is a large American slotting machine, two useful horizontal boring machines, and two large radial drilling machines. The two side bays, as mentioned above, are closely packed with a large variety of lathes, planes, slotting, and drilling machines, manufactured by Archdale, Whitworth, Craven Bros., McOnie and Co., and other well-known makers. Power for this part of the works is supplied by a large horizontal non-condensing engine, fitted with Meyer's expansion valves, while in an engine-room immediately adjoining is a large double-cylinder engine of about the same power, ready to be put into operation at once should the necessity arise, it being a principle of the management to take all reasonable precautions to prevent stoppage of the works in the event of a breakdown. Steam for these engines is supplied by two large Lancashire boilers at a pressure of 75 lbs. per square inch, one always being laid off for cleaning while the other is at work.

**Foundry and Other Shops.**—Passing now through a small auxiliary machine shop containing a number of lathes, wheel cutting, milling, and other machines, which, owing to the increase of business it became necessary to put into operation, one comes to the foundry. This building before its transfer to the present company was used as a shot and shell foundry, evidence of its former activity in this respect in the shape of huge projectiles being met with all over the extensive premises. The foundry is equipped with two 2-ton cupolas and a large new cupola with drop bottom and all the latest improvements, and capable of melting 8 tons of metal per hour, the blast for these cupolas being supplied by a large Roots blower. The foundry is served by one large jib crane capable of lifting 15 tons, one 3 ton, and several smaller cranes. Immediately under the jib of the 15-ton crane is a large circular steel casting pit capable of casting propellers up to 18 ft. in diameter. A similar, but smaller, pit is sunk under the jib of the 3-ton crane. Situated as these works are on a vast alluvial flat on what is practically a water-logged soil these pits are a necessary adjunct to any foundry turning out castings of large size, and the same thing applies to all kindred establishments in the Shanghai district. The brass foundry contains three ordinary and one Carr's patent crucible furnaces, and a great variety of brass castings ranging from a few ounces

to several hundredweights are being constantly turned out.

**Smiths' Shop.**—Adjoining the foundry is the pattern-makers' shop, and in close proximity is the smithy. This latter shop contains a large steam-hammer, served by two 4-ton jib cranes, and capable of welding propeller shafts up to 14 ins. diameter, which has frequently been done in these works. Two other smaller steam-hammers are provided for ordinary work, and all are in constant use, the smithy in works of this kind being generally a very busy shop indeed. The coppersmiths' shop adjacent to the smithy is also usually well supplied with work, but calls for no special comment. Rails are laid from the wharves and dock into the various shops for the expeditious handling of heavy pieces of machinery. The whole of the shops, dockyard, and offices, including the Admiralty House, are effectively lighted by electricity, while an efficient water service, supplied by water from the adjacent Shanghai Inland Water Works, with numerous hydrants all over the works, testifies to the care and thoughtfulness of the management.

**Facilities for All Kinds of Repair Work.**—The engineering department is specially equipped for the expeditious handling of all kinds of marine repair work from the renewal of plates to the lengthening of any kind of a vessel while the installation of machinery and repair thereof outside of marine work is becoming an important feature of the company's activity.

**Construction.**—Chinese waters are dotted with the output of steel and teak-wood vessels ranging from a cargo lighter to Imperial cruisers that represent the capacity of the company's plant. Among the important vessels turned out in recent years, especial attention is directed to the steel twin screw yacht *Lien-ching* built for H. I. H. Prince Tsai Tsun. This vessel has a displacement of 500 tons and is one of the most handsome in appearance turned out in Far Eastern yards. Its dimensions are: Length, 173 feet over all; beam, 25 feet; depth, 20 feet; draught under steam, 9 feet. The vessel is divided into eight compartments including six water-tight bulkheads and bunker bulkheads and has three decks. The Imperial compartments are aft the main deck while the deck forward is devoted to a handsome reception hall. Two Scotch boilers, equipped with Howden's forced draught system, supply steam at a pressure of 180 pounds provide motive power expressed by two sets of triple expansion engines, cylinders 10, 16.5, and 26.5 inches in diameter respectively with an 18 inch stroke, h. p. indicated, 900. Air and circulating pumps constructed by the Kiangnan company and Weir's feed pumps are installed. The most modern steam steering control is part of the modern equipment and the electric light plant installed has a capacity of 6,000 c. p. At the speed trials the vessel easily maintained 14 knots.

The Kiangnan Works employ about 500 Chinese who are found exceptionally efficient under European supervision as is generally provided in the different departments.



# THE FAR EASTERN REVIEW

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# DEVELOPMENT OF SHIPBUILDING IN JAPAN

In presenting a general review of shipbuilding in the Far East an effort has been made to give a comprehensive idea of the large part that shipbuilding and engineering works are taking in the development of Oriental trade and the encouragement of local industries. And perhaps the most striking feature of shipbuilding development with which we have to do is that so closely connected with Japanese history during the last 20 years.

A native canoe-shaped craft utilized in fishing and trading along the coast of Japan and with Korea during the third century gave place in the fourth century to vessels constructed after Korean models. Following Korean construction communication with China by sea was established and a combination of Chinese and Korean junk construction seems to have been adopted generally, but up to the end of the tenth century vessels of over 100 tons were exceptional. It might be said that not until 1542, when the Portuguese began trading with Japan, was any attempt made to construct vessels of sufficient size to venture beyond local waters, but about this time it is known that Japanese vessels navigated Eastern Seas as far South as Australia.

The latter part of the seventeenth century the registered vessels operating under the Shogun government's licenses numbered 200, many of them from 100 to 130 feet in length. European methods were first introduced by William Adams, the shipwrecked English pilot who made his home in Japan and engaged in the shipbuilding trade. He built two modern vessels of approximately 100 tons each about 1635 and there was every indication of renewed activity in this line of endeavor, but in 1638 the Shogun government restricted foreign trade to China, Korea and Holland, prohibited the construction of ships western type and intercourse with foreigners, and until 1853, or over 200 years, only small junks for the coasting trade were built in Japan.

With the advent of Commodore Perry the limit on the size of ships constructed was raised, but little progress was made in modern construction.

In 1854 Captain Putiatin of the Russian man-of-war "Diana," having suffered shipwreck at Shimoda, decided to construct a ship of 200 tons in which to return to Russia and a temporary shipyard was established at Kimizawa near that place. The Japanese shipwrights employed continued the yard and built several vessels of the same type. They became known as the Kimizawa type.

The first steam warship owned by Japan was presented by the Dutch government in 1855 which was followed by the purchase of a screw-propelled warship purchased by the Shogun from Holland in 1857. Following this was a present from the late Queen Victoria to the Shogun of a steam yacht.

It was at this juncture that the Government of the Shogun became interested in shipbuilding. A site for yards was chosen at Nagasaki in 1857 and Dutch shipwrights and engineers placed in charge. Then followed works at Yokohama, Yokosuka and Ishikawajima by the government and in 1864 the Chiyodagata, the first warship propelled by a steel screw, was constructed at the last named yard.

In 1861 private ownership of western type vessels was permitted and that date may be said to mark an almost imperceptible beginning of Japan's phenomenal maritime development and especially in the department of shipbuilding and engineering construction.

In 1876 Mr. I. Hirano leased the Ishikawajima Engine Works, owned by the Navy Department, and this was the first important western shipbuilding enterprise under private direction established in Japan. Following it were the works at Osaka established by Mr. E. H. Hunter, 1880; the purchase of the government works at Nagasaki by the Mitsu Bishi firm in 1884 and the establishment of the Kawasaki works at Kobe in 1886. In 1894 the Kosuga-maru, 1,500 tons displace-

ment, constructed by the Mitsu Bishi, was the largest vessel that had been built in a Japanese dock as the great majority of vessels owned by local shipping companies were purchased abroad.

The Sino Japanese war gave quite an impetus to the industry, but it was not until the passage of the encouragement act of 1896 that Japan's remarkable progress in this line of activity began. Then followed the construction of the Hitachi-maru by the Mitsu Bishi Dockyard of 6,000 tons with seven other steamers of 3,000 tons each completed by 1899. The Mitsu Bishi continued building larger vessels for the merchant marine until the recent construction of the Tenyo and Chiyo Maru of 13,400 tons equipped with turbine engines crowned the splendid record of achievement by this company.

As an evidence of the success of the Encouragement Act may be noted the increase in the number of shipyards from 66, in 1896, with an output of 36 steamers aggregating 5,860 tons and sailing craft 950 tons, to 240 shipyards turning out 67 steamers with an aggregate tonnage of 50,795 tons in 1909 and sailing craft of 15,188 tons.

In naval construction Japan has made the most wonderful strides. Up to 1883, the largest vessels turned out were wooden gunboats of about 1,500 tons. Then followed composite and steel construction and, in 1891, the coast defence ship Hashidate of 4,000 tons was completed. This was the largest warship built until 1906 when the battleship Satsuma, 19,200 tons, was constructed by the Yokosuka Dock Yard. The first steel cruiser of 1,750 tons was launched at Kobe in 1888.

The Government established naval dockyards and arsenals at Kure and Sasebo in 1889. A dispatch boat of 1800 tons was launched in 1897 from the Kure yards. All the armor and guns are furnished from the Kure arsenal. The battleship Aki of 19,800 tons was constructed here and with the improvements made super-dreadnoughts may be turned out with expedition. The latest naval construction is the Battleship Kawachi at the Kokosuka yards, and the Settsu at Kure, each having a displacement of 20,850 tons and a speed of 20.5 knots.

And so no term other than revolution may be used to express the transformation that has taken place in the last fifteen years in Japan's shipbuilding industry. Every year records some improvement, some advancement that keeps her abreast of the times.

When Japan set out to make a place for herself among the leading maritime nations of the world, she recognized the seriousness of her task and the many sacrifices involved in the realization of her ambition. There was a singleness of purpose predominating that could not have been realized were it not for the patriotic support given by the taxpayers of Japan. The statesmen who have been directing national affairs during the last twenty years have been fully justified by results and in no department of industry has this been demonstrated more strikingly than in the wise policy of encouragement to Japanese shipbuilding and foreign carrying trade. At one time criticism of this policy took the form of accusation in that Japan's statesmen had been guilty of promoting class legislation designed to build up a special industry at the expense of the Japanese taxpayer. But those critics have been silenced by the era of general development in all branches of trade and industry following the predominance of Japan's ships upon the Pacific and in the presence of her flag in the world's leading marts. There has evolved a national pride in her extensive merchant marine that represents in addition to its commercial potentiality a force for auxiliary naval defence unequalled by any nation with possibly the exception of Great Britain. And it all involved great faith in the nation's future, statesmanship of a high order and the sacrifice that honors a nation.



## THE MOTOR BOAT INVASION

During the last few years, the internal combustion engine has been perfected and its effect upon water transportation facilities is now phenomenal. The year has been marked by Lloyds' adoption of rules governing the survey of internal combustion engines using petrol or paraffine fuel. This has been due to the advance made in adapting this class of engine to large vessels, and the growing interest in marine motor power in this form.

But what is more striking is the strides taken in utilizing the internal combustion engines for motor power for small craft, and extending their use to the cargo and passenger carrying trade in the shallow streams and river deltas. When first introduced the motor boat became the ideal small pleasure craft and no doubt the sporting interest in increased speed had much to do with the development of this modern engine which has invaded the ends of the earth.

In this special number will be found evidence that the progressive shipbuilding yards of the Far East, no matter how extensive their operations, are not neglecting motor craft construction. Indeed, if one is to judge by the hundreds of ways in which the motor engine is being utilized to facilitate local trade in the many deltas and small rivers in the different far eastern countries and dependencies, it would seem that this means of transportation is doing more to "hurry the east" than any other influence. The laborious poling of the casco and lighter is giving place to more certain muffled motor power of the internal combustion engine. It may be adapted to the banca, the lorchas, the sampan or the native prao. For the carrying of mails it serves towards rural delivery expansion and its adaptability to light cargo and passenger traffic places formerly isolated sections within easy reach of desirable markets. The motor boat is doing much to supplement the work of the great ocean liners by expediting local distribution. It finds a market for the isolated producer and encourages greater industry and necessarily greater prosperity. The Philippine customs finds the motor boat the ideal cutter to run down smugglers; the revenue department invades the interior and enforces the law with a case of gasoline; while the tourist and hunter board a motor boat at Manila and spend weeks among the most delightful scenic attractions of the islands. The Canton delta has its fleet of motor boats and in Shanghai, Hongkong, Singapore, and Bangkok motor boat construction is becoming a most important feature of the shipbuilding industry.

The development of the petroleum marine engine in recent years has been given a great deal of attention and its popularity promises to greatly increase as its durability and adaptability to local conditions becomes more generally accepted. European and American manufacturers have brought the petrol or gasoline engine to a high state of efficiency and they have been actively engaged for years experimenting on various models of kerosene motors. That their efforts in this direction are meeting with success is demonstrated by the increased number of reputable kerosene motors on the market. European and American manufacturers of internal combustion engines cannot fail to secure unusual returns for well directed effort introducing their motors in Far Eastern countries where the appreciation of that class of motor power is becoming more and more marked.

## DECREASING THE DANGER OF DIVING

The writer had an opportunity to view the antiquated diving methods employed on harbour improvements some years ago in an Australasian port. The diver came up before his usual time, and brought with him an octopus that must have measured a good ten or twelve feet from tip to tip of tentacles. It was clinging to his back, twined round all his limbs, but fortunately had not anchored itself to any of the rocks or piles. The beast objected to his atmospheric bath and slid back into the sea through a two inch gap between the planks of the wharf.

Dangers of this kind are inevitable to the diver's art, but much has been done of late years to protect him from perils of faulty apparatus and inefficient means of communication. A number of these improvements are due to Messrs. C. E. Heinke & Co., of London. The pumps, dress, helmet and boots have all received attention.

Slight improvements have been made from time to time until the aggregate of changes has become very considerable. The old style diving dress was by no means a comfortable garment. The seams at the feet and neck leaked; the pressure of the wrist outlets numbed the hands; the cut of the sleeves prevented the hands being brought together at the front without great discomfort and chafing. Messrs. Heinke have at length found how to make a foot with but one seam, how to form a watertight cuff without undue pressure, and how to reinforce seams without making the dress unwieldy and stiff. Their latest pattern of boot consists of a solid brass casting for protection to the foot. An ingenious arrangement of straps prevents the foot from being accidentally withdrawn. Every detail of the equipment has received the same minute care.

For light, the diver is offered his choice of oil or electric lamps. The former is supplied with air through a branch hose from the air pump. The latter are fed by a special robust flexible cable. For communicating with the attendants above, there is a patent speaking apparatus that depends for its action on an extra air tube, fitted with sound discs in the diver's helmet. A more elaborate device consists of a telephone adapted for submarine work. Transmitter and receiver are suitably placed inside the helmet, and a call button operated by the diver's chin. The conductors can be embedded in the rubber wall of the air tube or in the life line. The equipment for the use of two divers working together makes provision for communication between them as well as to those on boat or land.

The uses to which Messrs. Heinke & Co.'s apparatus has been put form a romance in themselves. When the S. S. "Japan" was burned the first Heinke suit ordered was lost in a wreck. Another was then sent out, the first recovered by its use, and both were then successfully employed to save £77,000 worth of gold and silver coin in fused masses. Seven of the most celebrated divers have, by the use of this apparatus, salvaged between them over £10,000,000 of bullion and over 100 vessels. Another curious case was the recovery of a chased silver hunting knife valued at £7000. This was recovered from the S.S. "Cadiz," wrecked off Ushant, after two months submersion.

In pearling naked diving is being fast replaced by diving with apparatus, and it speaks well for the manufacturers that a round thousand of Heinke outfits are in daily use by semi-savage operators.

Homelier uses for this apparatus are found in dock and harbour constructions, dock working and maintenance, emergency ship repairs and a hundred and one other branches of the marine industry. For all purposes, Messrs. Heinke & Co. turn out over seven hundred equipments yearly. Their wide experience and personal knowledge of diving work serve to maintain their position as leading Submarine Engineers.

## A MARINE VIEW OF ELECTRICAL PROGRESS.

It is plain to the most casual observer that matters maritime are being rapidly brought under the domain of electricity. The peculiar convenience and flexibility of this form of power have quickly appealed to the business instincts of shipbuilders and naval engineers, and its use has grown from small beginnings until the largest yards and docks are now electrically driven throughout, and electric propulsion of ocean liners and battleships is in the immediate future. The rapidity of this advance has been greatly helped by the enterprise of the great electrical manufacturing interests.

The use of electricity on shipboard was for long confined to lighting, where its popularity was clearly due to its handiness and safety. At the present time electric devices of every kind are to be found on the great ocean liners—fans, lifts, and a dozen other appliances minister to the comfort of passengers, while in winches, pumps, tools, forced draught fans, and coal conveyers, electric power is helping the shareholders to higher dividends. It is in the navy, however, that the same principle has been carried to its greatest development.

A full list of the uses made of electric power on battleships would make the present article like an auctioneer's catalogue. It will be enough to mention gun laying, ammunition hoists, torpedo charging, and the automatic closing of watertight compartment doors as examples of what is being done.

The proposals for marine propulsion on a practical ocean-going scale are so numerous and so untried that this is hardly the place to deal with them. Turbo-electric schemes have now been worked out in great detail, and much ingenuity expended on them. Actual designs have been quoted on to various interested bodies, including some of the great naval powers. One of the most promising patents in this field is held by Mr. J. N. Bailey—an engineer of one of the Westinghouse Companies.

For shipbuilding purposes electric power has become indispensable, owing to the large area covered by a modern shipyard, and to the peculiar nature of the problems involved in putting up the frame and plates. No other system of power distribution can economically solve this problem, or can provide for the rapid concentration of power at the necessary point in cases of emergency. The dockyards of the British Admiralty afford an example of the individualised electric drive applied to shipbuilding and naval work. Here motors of all sizes are employed for machine tool drive. The ease with which electric power may be accurately measured has enabled the dockyard authorities to test the power consumption of their tools, and in this way a mass of most valuable information has been collected. In the Boston yard of the U. S. Navy, there may be seen a particularly interesting dry dock pumping plant. Direct coupled centrifugal pumps are used, designed to have an increasing efficiency with increasing head. As the dock empties the head becomes greater, and, with a constant flow of water, more load comes on the pump. The increased efficiency makes for a constant load on the motor. Individual driving, at any rate for the larger tools, is surely winning a victory over the group drive. The brightening of the shop due to the absence of shafting and belts, the economy of eliminating idle gear in motion, the ease of arranging for overtime in certain tools—these are advantages too valuable to be overlooked by the wide awake shop manager.

Until comparatively recently, many engineers considered that electricity could not satisfactorily replace hydraulic power for cargo handling appliances. This idea has now been completely exploded, and received its final death blow a few weeks ago, when Messrs. Dixon and Baxter read their paper before the Institution of Electrical Engineers on the equipment of Rothesay Docks. Cranes, coal tipplers, elevators, and capstans are now being electrically driven in all parts of the world, and doubtless the Far East will not be behind hand in adopting this most convenient of all systems.

**PROPOSALS FOR COAL.**—Headquarters Philippines Division, Office of Chief Quartermaster, Manila, P. I., January 7, 1911. Sealed proposals in triplicate, subject to the usual conditions, for furnishing approximately 65,000 tons of coal to the Quartermaster's Department, U. S. Army, during the Fiscal Year 1912, will be received here until 11:00 A. M. May 8, 1911, and then opened. Information and blank forms furnished upon application. F. G. HODGSON, Assistant Quartermaster General, U. S. Army, Chief Quartermaster.



# THE NICOLAS TSU ENGINEERING WORKS, SHANGHAI

In contrast with the remarkable engineering advancement of Japan, is the apathy of China in these industries which make for national progress. Engineering is still in its infancy in China, and there are no characters in her language to convey the meaning of the simplest technical terms. Aside from the great Han-yang Iron & Steel Works, and a few small machine shops in the treaty ports, engineering



ENGINE FOR STEAMER BUILT IN NICOLAS TSU'S SHOPS



GENERAL VIEW OF SHIPBUILDING YARD OF THE NICOLAS TSU ENGINEERING WORKS, SHANGHAI



TRAILER CAR, TYPE B; BUILT BY THE NICOLAS TSU ENGINEERING WORKS FOR THE SHANGHAI AND FRENCH TRAMWAYS



STEEL WATCH TOWER WITH ALARM BELL, FOR THE CHINESE CITY, SHANGHAI



DIRECT ACTING PUMP, BUILT BY THE NICOLAS TSU ENGINEERING WORKS FOR THE CHINESE INLAND WATER WORKS, SHANGHAI. CYLINDER 26" DIAMETER: STROKE 52" 30 R. P. M.: CAPACITY 4,000,000 GALLONS IN 24 HOURS



is in the hands of foreign concerns. Railways are being constructed, mills and electrical plants installed, and mines opened, but for lack of trained and efficient technical men, the machine shops and foundries of China are controlled by foreigners. It is therefore a surprise to find in Shanghai an engineering and shipbuilding works, operated and controlled by Chinese capital, under Chinese supervision, comparing favorably with some of the large foreign establishments of the Orient.

A visit to the Nicolas Tsu Engineering and Shipbuilding Works, located on the Whangpoo River near the Kiangnan Arsenal, is a revelation to the foreign engineer. Here is found a complete up to date plant, with French equipment turning out all kinds of engineering work, run under the direction of Mr. Louis Tsu, a graduated engineer from one of the French technical colleges.

The works comprise the machinery and fitting shop, iron and brass foundries, blacksmith shop, boiler makers' shop, carpenter and model shop, railway car erecting and finishing shop,

shipbuilding yard, oil engine and electrical shops, technical and drawing office.

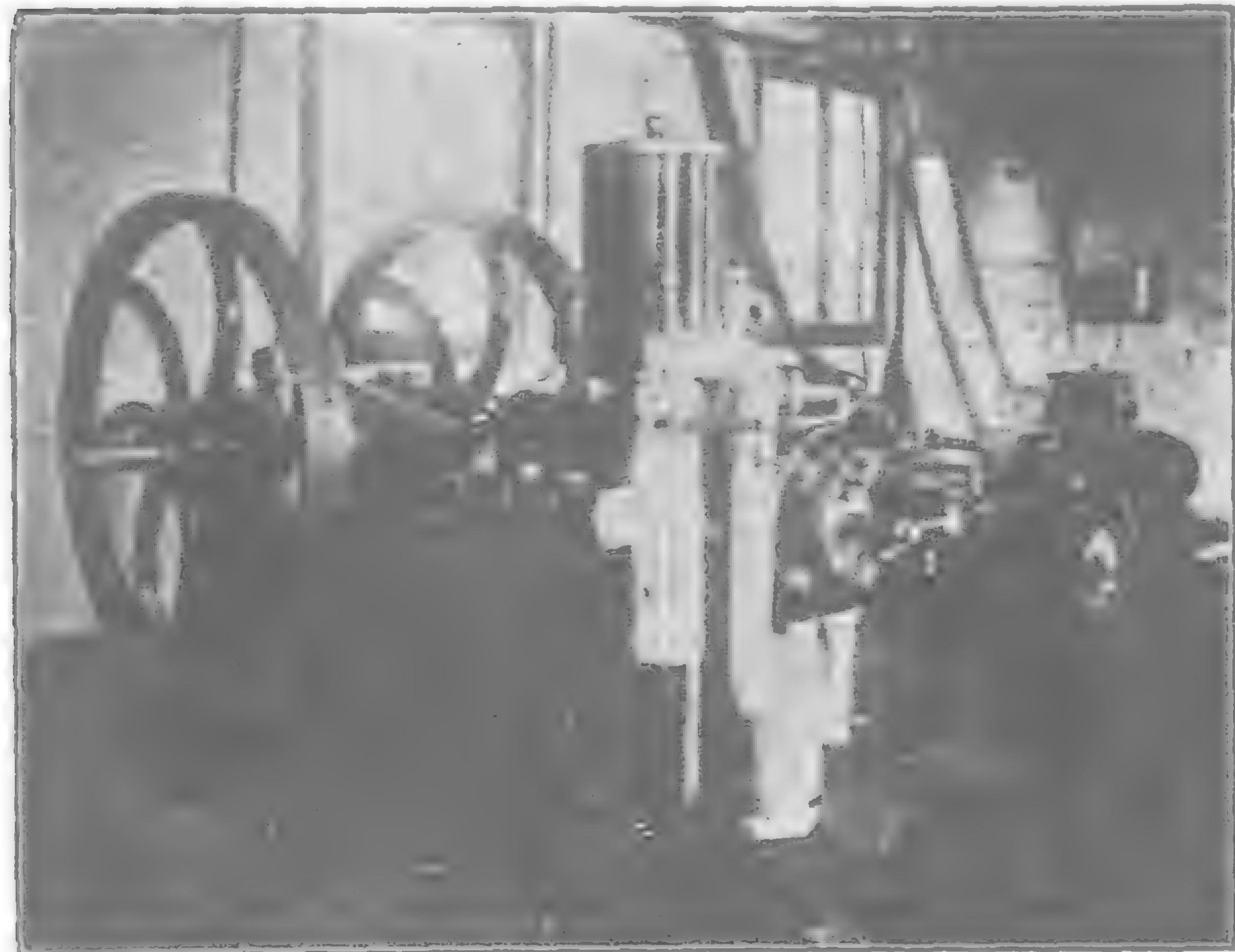
The staff and workmen number over 500 men, and the works cover an area of 11 acres. The works specialize in many machines and it is interesting to note the progress made along lines hitherto considered as exclusively foreign in China.

With the construction by native capital of the Kiangsu and Chekiang railways it was quite natural that their patronage would be tendered to a Chinese firm, especially when the latter's works are located only a short dis-

tance from the Shanghai terminus of the line, and with the orders of these companies as a start, the Nicolas Tsu Works have firmly entered the field for participation in the supply of Chinese railway material.

Passenger and freight cars, bridges, water tanks, crossings, switches, rail fastenings, pile drivers, jacks, winches, cranes, drills, etc., have been made to the order of various railways. A few of the special orders will give a better idea of the extent of their activity.

*Railway Material.*—Steel Roadway Bridge for Ningpo, 200 ft. long in 3 spans. For the



25 H. P. KEROSENE ENGINE MADE BY THE NICOLAS TSU WORKS



GENERAL VIEW OF NICOLAS TSU ENGINEERING WORKS



CORLISS ENGINE BUILT BY THE NICOLAS TSU ENGINEERING WORKS FOR THE CHINESE INLAND WATER WORKS, SHANGHAI. DIAM 62 X 52 STROKE; DIAMETER OF FLY WHEEL, 22 FT., 30 R. P. M., COMPLETE WITH CONDENSER AND AIR PUMP

Chekiang and Kiangsu Railways many steel girders for bridges 20 to 100 ft. long were constructed; 2 railway passenger coaches for the Kiangsu Railway; 6 30-ton freight wagons for the Kiangsu Ry.; 12 passenger coaches, 1st, 2nd and 3rd class, following the type of those on the Shanghai-Nanking line, were built for the Chekiang railway, and the water tanks, pile drivers, jacks, winches, crossings, switches and rail fastenings for the Szechuen-Chuen-han, Chekiang and Lo-tung railways. Several trailer cars for the Shanghai and French Tramways were also built.

*Shipbuilding.*—The works have successfully built and engined: One steam cargo and passenger boat, 160 ft. long and 350 H. P.; two steam cargo and passenger boats 140 ft. long and 300 H. P., for Chinese Navigation Companies; several steam tow boats 70 to 90 ft. in length for the Szechuen-Chuenhan Railway and the Hanyang Iron & Steel Works.

Three shallow draft steamers, 60 ft. long 2 ft. draft; 70 ft. long 2 ft. 6 inch draft; and 90 ft. long, 4 ft. draft, were built to the order of the China Merchants Inland Navigation Co. Steel lighters from 100 to 300 tons for the East Asiatic Dredging Co. and the Szechuen Railway and the pontoons and pontoon-hulks from 180 to 250 ft. long for the Yangtze service of the Cie. Asiatic de Navigation and others have been constructed at Tsu's works.

Kerosene and gasoline motors, for marine and stationary work from 5 to 25 h. p. are made for the native trade, and many small rice and ginning mills are being operated with Tsu's engines.

Complete Oil Mill machinery has been furnished the Shanghai Cong Chong Cotton Seed Oil Mill with a capacity of 1,500 piculs of seed in 24 hours. Complete oil and bean cake plants to the "Yu Shing Bean Oil Mill in Anhui, consisting of 60 presses, and 100 presses to the "Hai Foon" Bean Oil Mill at Haichow, besides several smaller plants. Rice cleaning and





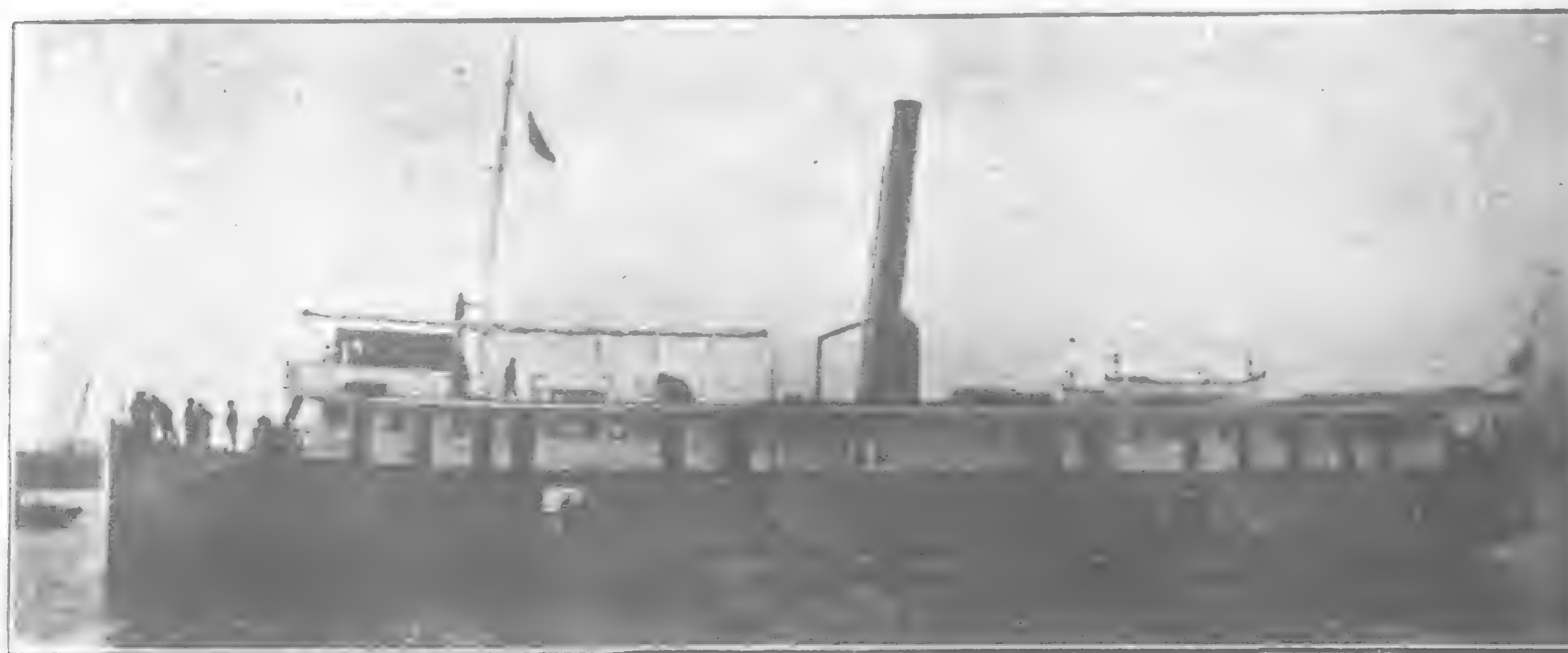
RAILROAD BRIDGE OF 60 FOOT SPAN CONSTRUCTED BY NICOLAS TSU FOR THE KIANG-SU RAILWAY CO.



VIEW OF 12 PASSENGER CARS IN COURSE OF CONSTRUCTION FOR THE CHEKIANG RAILWAY CO. (1ST, 2ND AND 3RD CLASS) AS CARS ON SHANGHAI-NANKING RY.



TRAILER CAR, TYPE C, BUILT BY THE NICOLAS TSU ENGINEERING WORKS FOR THE SHANGHAI TRAMWAYS



STEEL S. S. "HSINTAI," DISPLACEMENT 291 TONS, SPEED 11 KNOTS. DIMENSIONS 160' X 21' X 10'. DRAFT 8' COMPOUND CONDENSING ENGINE 320 H. P. TO CARRY 300 PASSENGERS: BUILT BY THE NICOLAS TSU ENGINEERING WORKS



STEEL SHALLOW DRAFT PASSENGER BOAT "HENG HSIN" BUILT BY THE NICOLAS TSU ENGINEERING WORKS FOR THE CHINA MERCHANTS INLAND NAVIGATION CO.

hulling machines are made at the works, and with the small kerosene oil engines, make a compact plant, suitable for the small farmer. Machines with capacities from 60 to 600 piculs per 12 hours are made and marketed.

Engines and boilers from 40 to 350 H. P., and one complete set of Corliss 28" X 52" engines and 18" X 52" pumps with condenser and air pump were supplied to the Chinese Inland Water Works at Shanghai, having a capacity of 4,000,000 gallons in 24 hours. Minting machines for the new copper coins were supplied to the Kiangsu and Fengtien Provincial Mints.

The steel chimney for the Hupeh Cement Works, 200 ft. high and 11 ft. diameter, bell and whistling buoys for the Imperial Maritime Customs, letter boxes for the Postal Department, the Customs' jetty at Shanghai, the staircase for the Shanghai Club, and many other varieties of work have been executed.

The success of this firm has encouraged them to further expansion of the works, and in due course new high speed machine and special tools will be added.

A dry dock and steel casting plant is contemplated, which will not only enable them to compete with the other local concerns, but permit the production of finished and complete machines of all kinds entirely within the works.

#### WILKS & JACK, LTD.

This firm was founded at Hongkong in 1902 by Mr. E. C. Wilks, M. I. Mech. E., as a marine engineer's and surveyors' bureau. Mr. Wilks was joined in 1903 by Mr. W. C. Jack, M. I. N. A., formerly Ingénieur en Chef of the Tonkin River Mail Service, and afterwards assistant manager at the Kowloon establishment of the Hongkong and Whampoa Dock Company.

The firm has designed and superintended the construction of a large number of river steamers and launches. In December, 1906, the business was converted into a limited liability company, under the style of Wilks & Jack, Ltd., with the former proprietors as general managers.

The firm submits designs and estimates for steamships and launches for sea or river service, and make a speciality of craft of lighter draft. Vessels are inspected and trial trips run on behalf of prospective purchasers.



# THE OSAKA IRON WORKS

This successful enterprise that has won a prominent place among the leading industrial enterprises of Osaka was inaugurated in 1880 by E. H. Hunter, Esq., a prominent importer and exporter of Kobe who during

Work began to pour in from the day the works were opened and in 1884 it became necessary to reconstruct the dock in order to repair the steamer Mikuni-Maru. The reconstructed dock was built of granite.

E. H. Hunter who had been taking an eight years course abroad, had returned and assumed the management. He proceeded at once to refit the works. The original yard was turned into the present engine and boiler shops and



THE OSAKA IRON WORKS: HEAD OFFICE AND WORKS AT AJIKAWA, OSAKA, JAPAN

many years of residence realized the necessity of shipbuilding yard and engineering, works for the repair of vessels, thus increasing the attractiveness of the port for the carrying trade. With five Japanese partners, he secured a site at a desirable point on the Ajikawa River, Osaka, and the construction of building was expedited. Machinery was installed and the works constructed at great outlay.

While Mr. Hunter continued sanguine of success, his Japanese partners lacked his courage and before the works were completed, they retired one by one until Mr. Hunter was left to bear the whole burden and responsibility for the success of the enterprise, financially and otherwise. He did not falter and his whole fortune was invested as an evidence of his faith in the venture. His tenacity of purpose, his resourcefulness, and his ability, won for him success in large measure.

The first boiler constructed in Japan is to the credit of these works.

It soon became necessary to extend the works to meet the requirements of the increased volume of business. The result was the Kiyamachi plant on the south beach of the Ajikawa completed in 1889 for the construction of wooden vessels.

Then followed several years of depression but there was no lack of courage in tiding over the hard times. Mr. Akizuki, the Japanese manager during this period, was largely responsible for the success of the struggle which finally ended with the outbreak of the China-Japan war when government orders came pouring in. Then in 1900, the business was further advanced by the Imperial Shipbuilding Encouragement Act. To benefit from this legislation it became necessary to rebuild the entire works. Fortunately at this time Mr. Roytaro Hunter, the eldest son of Mr.

a new site comprising twenty acres located at a point called Sakurajima, a mile from the old site near the mouth of the river inside the new harbor then under construction by the City Corporation. This new plant was equipped to construct steel vessels of all sizes and included other necessary shops for repair and engineering construction.

At this time the principal cities of Japan began installing modern water systems and Manager Hunter with his usual foresight decided to inaugurate a pipe foundry to meet this new demand. The early history of the foundry was far from satisfactory, due largely to lack of experienced direction. But finally Mr. Hunter and Mr. Konga, his assistant, solved the problem of making first class product with the result that the foundry has for years supplied pipe, not only to the principal cities of Japan but to Formosa and Manchuria as well. This was the first successful pipe foundry established in the Empire and stands as a



800 TON SELF-PROPELLING BUCKET DREDGER "SOTO MARU," BUILT BY THE OSAKA IRON WORKS FOR THE SOUTH MANCHURIAN RAILWAY COMPANY IN 1910.—DREDGING CAPACITY 800 TONS PER HOUR, DREDGING DEPTH 45 FEET, SPEED 8 KNOTS.



monument to the enterprise and courage of the management of the Osaka Iron Works.

In 1905 the Tempusan yard originally used for the repair of vessels on the harbor works was acquired from the City Corporation. This addition included two docks and is situated just opposite the Sakurajima Yards. They were completely remodelled and refitted and are utilized exclusively for repair work on vessels.

The Osaka Iron Works now occupy an area of 33 acres with immense water frontage and includes docks and shops for the manufacture and repair of all sizes of engines, boilers, steel and wooden ships, and cast iron pipes of all kinds. The Works also own a branch yard at Keelung, Formosa, with a dock capable of receiving vessels of 1,000 tons and is equipped for general engineering work, large contracts being undertaken for the Formosan government and private interests.

In addition to the present works at Osaka, plans for a new dock 500 feet in length have been completed and it is expected that the new extension will be in operation in 1911 when the river in Osaka will be dredged to an average depth of 25 feet.

The works now employ 3,500 skilled mechanics in the different departments.

The development of these works is typical of the remarkable history of the shipbuilding industry of Japan. During the war with China these works accomplished much in facilitating Government orders for repairs and for furnishing war materials, and during the war with Russia, the Works were so extended that they were utilized in refitting several warships with expedition besides building two new torpedo destroyers for the Imperial Navy.

In recognition of the splendid service rendered the Japanese Government, His Imperial Majesty conferred the Fifth Grade of the Order of Merit on Mr. Tyotaro Hunter and the Sixth Order was conferred on Mr. Kouga, Mr. Miyeshi and Mr. Shirato of his staff as well as recognition for others connected with the management during the war.

The officers of the works follow:

President and Proprietor, Ryotaro Hunter,



OSAKA IRON WORKS, NEW FOUNDRY UNDER CONSTRUCTION 150×90 FEET. FITTED WITH TWO 30 TON AND TWO TEN TON ELECTRIC OVERHEAD TRAVELING CRANES AND COMPLETE EQUIPMENT

Esq.; General Manager, Ukichi Kouga, Esq.; Manager, Mitsuisaburo Miyoshi, Esq.; Naval Architect, Bunichiro Fukuchi, Esq.; Chief Engineer, Sakutaro Takakura, Esq.

The head offices of the company are at Ajikawa-dori, Osaka.

#### HAKODATE DOCK COMPANY, LTD.

This dock located at Hakodate, on the Island of Hokkaido, is the most northern of the Japanese Companies. The works were first started with a patent marine slipway having rails 520 feet long, and capable of lifting vessels up to 1,200 tons gross. The increased shipping interests of this section demanded greater facilities, and a new granite drydock was constructed of the following dimensions:

Extreme length, 531 feet; length inside cais-

son, 503' 9"; length on blocks, 461 ft.; width at entrance, 81' 8" top, 71' 9" bottom.

The difference between high water at ordinary spring tides and at ordinary neaps is 2 ft. 8 in. The present channel of 20 ft. at low water leading to the dock is to be dredged to 25 ft. In addition there is a Berry's improved slipway capable of lifting a ship of 1,200 tons gross. These works are well equipped with up to date tools having a 2-ton steam hammer capable of forging 12-inch shafts. The foundry can handle castings up to tons. This is not a shipbuilding company, being confined to marine repairs, but many smaller harbor vessels and sailing craft, lighters, etc., have been turned out.

The company has a capital of Yen 1,800,000 of which Yen 1,200,000 is preferred and Yen 600,000 common stock.

#### THE TOKYO ISHIKAWAJIMA SHIPBUILDING YARD, LTD.

Main Office: Tsukuda, Tokyo. Officers and Directors: Managing Director, S. Umeura; Directors, T. Shimidzu, K. Sato, S. Tanaka. Auditors, E. Tanaka; M. Sato; S. Tomioka; Manager and Chief Engineer, T. Uchida; capital, Yen 1,020,000.

*Description of Docks.*—Length on bottom, No. 1, 299'; length on bottom, No. 2, 270'; width at entrance, No. 1, 41' 9"; width at entrance, No. 2, 32' 9"; depth on sill, No. 1, 14' 9"; docks can take vessels of about 1,000 tons gross.

Besides shipbuilding this concern has a large and increasing trade, outside of the regular marine line of work. It has never constructed any large vessels but has launched some 300 small craft mostly of wood. At present the works comprise 12 shops fitted with the most modern appliances, especially adapted for structural steel work. In this branch the Company has taken the lead, having erected most of the truss bridges in Tokio, and some of the larger railway bridges in other parts of the Empire. The largest steel building in Japan called the National Wrestling Hall, was designed, constructed and erected by this company. Electric generators, pumps, engines and other machinery is manufactured.



GENERAL VIEW OF THE HAKODATE DOCKYARD



# THE SHANGHAI DOCK & ENGINEERING CO., LTD.

The Shanghai Dock & Engineering Co., Ltd., is a combination of the two principal shipbuilding and engineering companies in Shanghai. Founded almost simultaneously, in the early

days of foreigners in China, they amalgamated in 1900, and now form the largest shipbuilding concern on the China Coast, with a capital of over Five Million Taels (roughly £700,000).

The Head Office is at the Old Dock, Broadway, Hongkew, opposite the Central or Pootung Works.

The area of the property is 96 English acres.



COSMOPOLITAN DOCK AND SHOPS



INTERNATIONAL DOCK AND WORKS



POOTUNG SHIPBUILDING YARD



CHINA MERCHANTS STEAM NAVIGATION CO.'S T. S. S. "KIANG HSIN," BUILT AND ENGINEED BY THE SHANGHAI DOCK & ENGINEERING CO., LTD. GROSS TONNAGE 3372; I. H. P. 3000





TUG "GENERAL WEEKS" FOR U. S. ARMY  
TONNAGE 416; I. H. P. 1232



N. D. L. TENDER "BREMEN"  
146' X 25' X 12' M. L. D.



FERRY BOAT "CLUTHAX"  
90' X 12' X 9' M. L. D.



ONE OF THE MACHINE SHOPS



ONE OF THE MOULDING SHOPS



GERMAN GUNBOAT "OTTER"  
IN INTERNATIONAL DOCK



FRENCH GUNBOAT "DOUDART DE LAGRÉE"  
IN OLD DOCK



LAUNCHES UNDER CONSTRUCTION FOR MANILA



LIGHT DRAFT STEAMER "PATROL,"  
BUILT AT POOTUNG



LAUNCHES FOR MANILA



WHISTLING BUOY FOR THE IMPERIAL  
MARITIME CUSTOMS



FRENCH RIVER GUNBOAT "OLRY"  
115' X 22' X 6' 6" M. L. D.  
BUILT BY THE S. D. & E. CO., LTD.

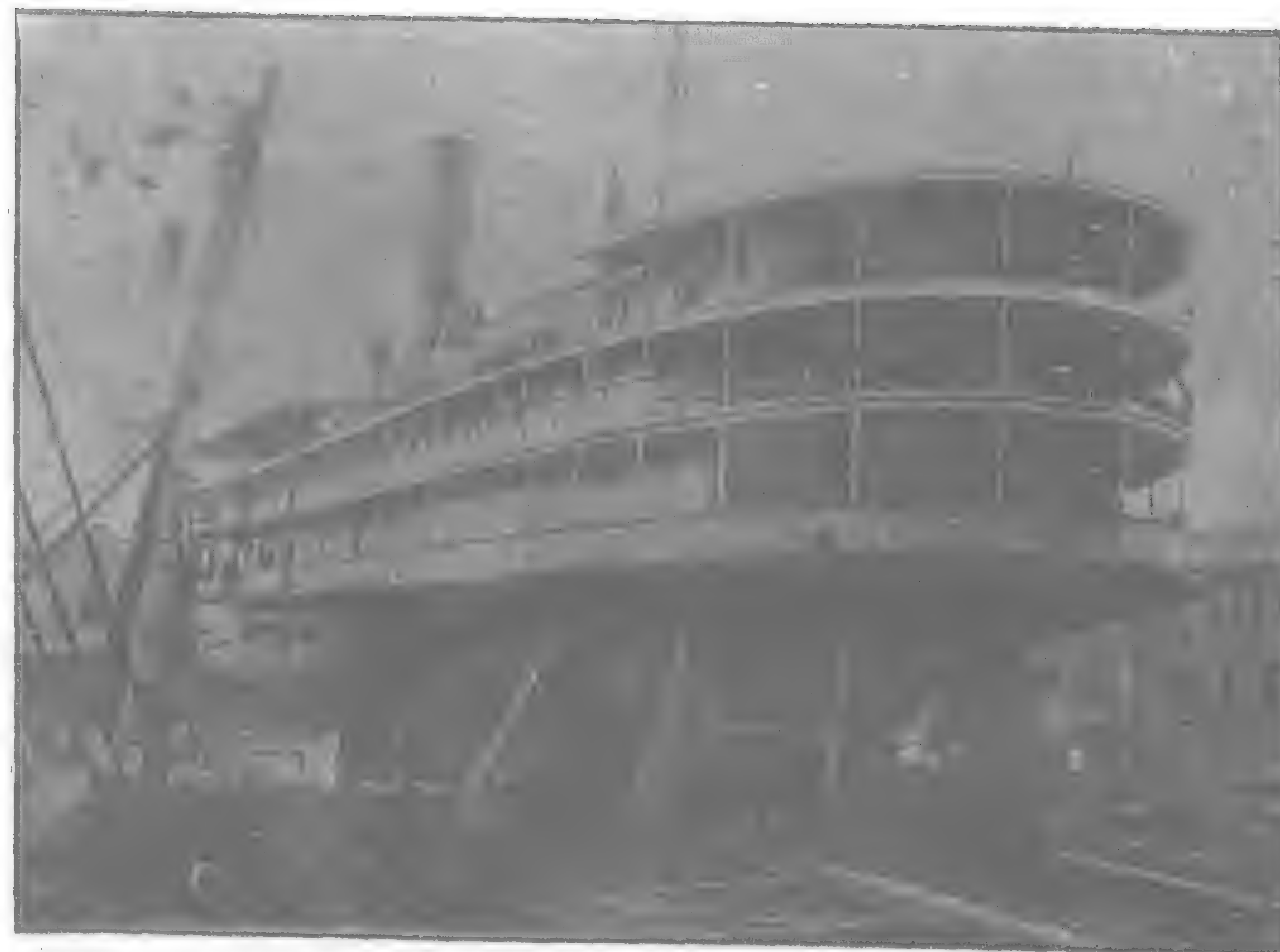


STERN OF S. S. "TOO NAN" REPAIRED  
BY S. D. & E. CO., LTD.





BEAM VIEW OF THE "KIANG HSIN" ON THE STOCKS



STERN VIEW OF "KIANG HSIN" SHOWING TWIN PROPELLERS



LAUNCHING OF THE STEAMER "SIANGTAN"



STEAMER "SIANGTAN" IN THE STOCKS





ENGINES FOR THE CHINA MERCHANTS' S. N. CO.'S T. S. S. "KIANG HSIN." TRIPLE EXPANSION, SURFACE CONDENSING ENGINES  
 $19''-31\frac{1}{2}''-52''$  W. P. 160 LBS  
 33"  
 TOTAL I. H. P. 3000

PART OF MACHINE SHOPS AT THE 'FOOTUNG WORKS



COMPOSITE COAST GUARD AND REVENUE CRUISERS FOR THE GOVERNMENT OF THE PHILIPPINE ISLANDS BUILT AND ENGINED BY THE SHANGHAI DOCK AND ENGINEERING CO. LTD.; LENGTH OVERALL-148; LENGTH B. P.-140; BREADTH-25; DEPTH-11'9"; SIZE OF ENGINES: H. P. CYLINDER-18"; L. P. CYLINDER-36"; STROKE-24"; I. H. P. 600. S. S. BALALAC, BASILAN, BUSUANGA, CORREGIDOR, LEYTE, LUZON, MASBATE, MINDANAO, MINDORO, NEGROS, PALAWAN, PANAY, POLILLO, SAMAR, TABLAS.



ENGINES OF THE CHINA MERCHANTS' S. N. CO.'S T. S. S. "KIANG." TRIPLE EXPANSION, SURFACE CONDENSING  
 $9''-14''-23''$  W. P. 175 LBS  
 15"  
 TOTAL I. H. P. 850

ENGINES OF THE S. S. "HSIN KONG." TRIPLE EXPANSION, SURFACE CONDENSING,  
 $19\frac{1}{2}''-31\frac{1}{4}''-52''$  W. P. 160 LBS  
 36"  
 TOTAL I. H. P. 1300

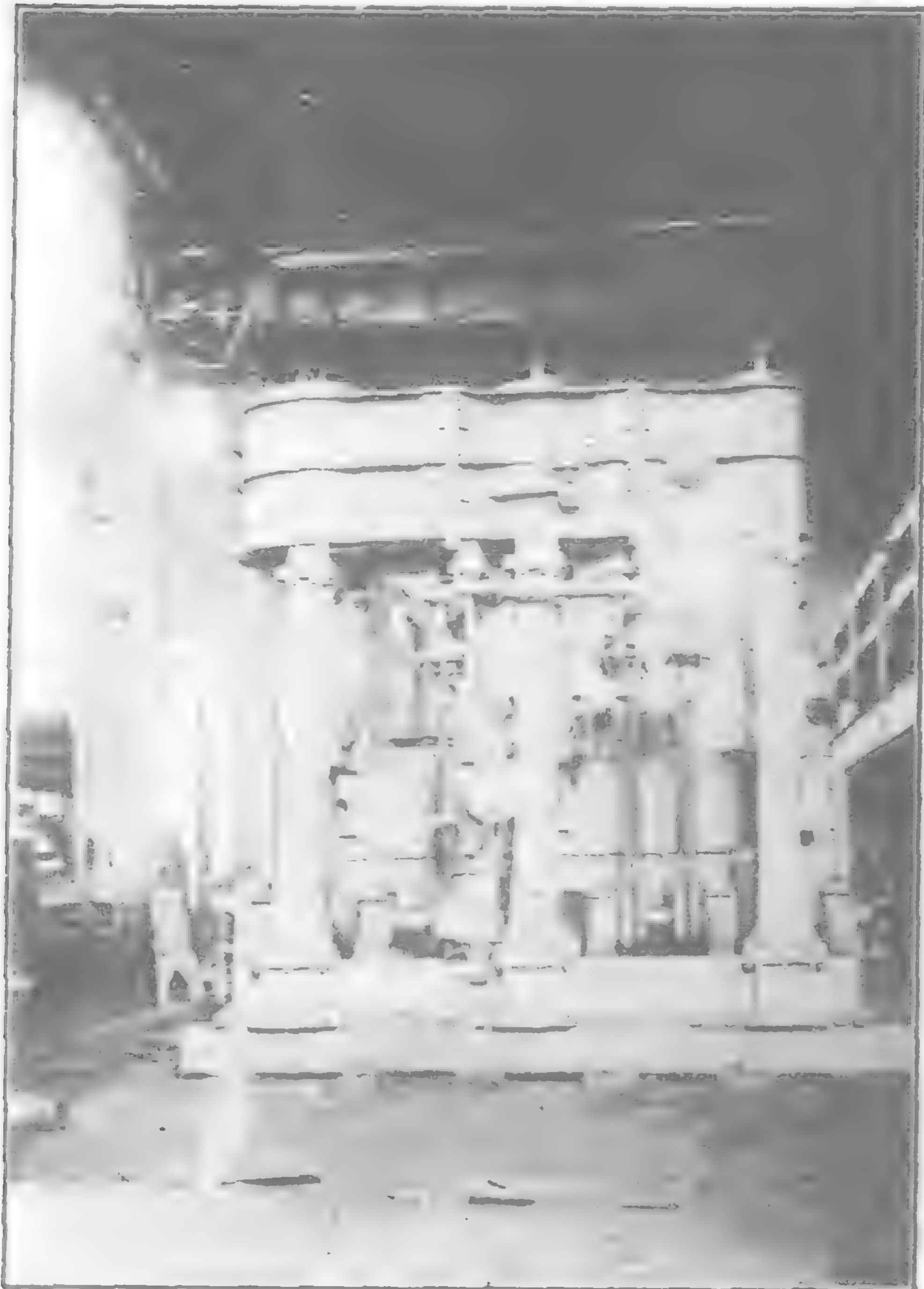


with a river frontage of about  $1\frac{1}{2}$  miles in length. Wharves and pontoons are so arranged that vessels can moor alongside during repairs or in the stream at head and stern moorings.

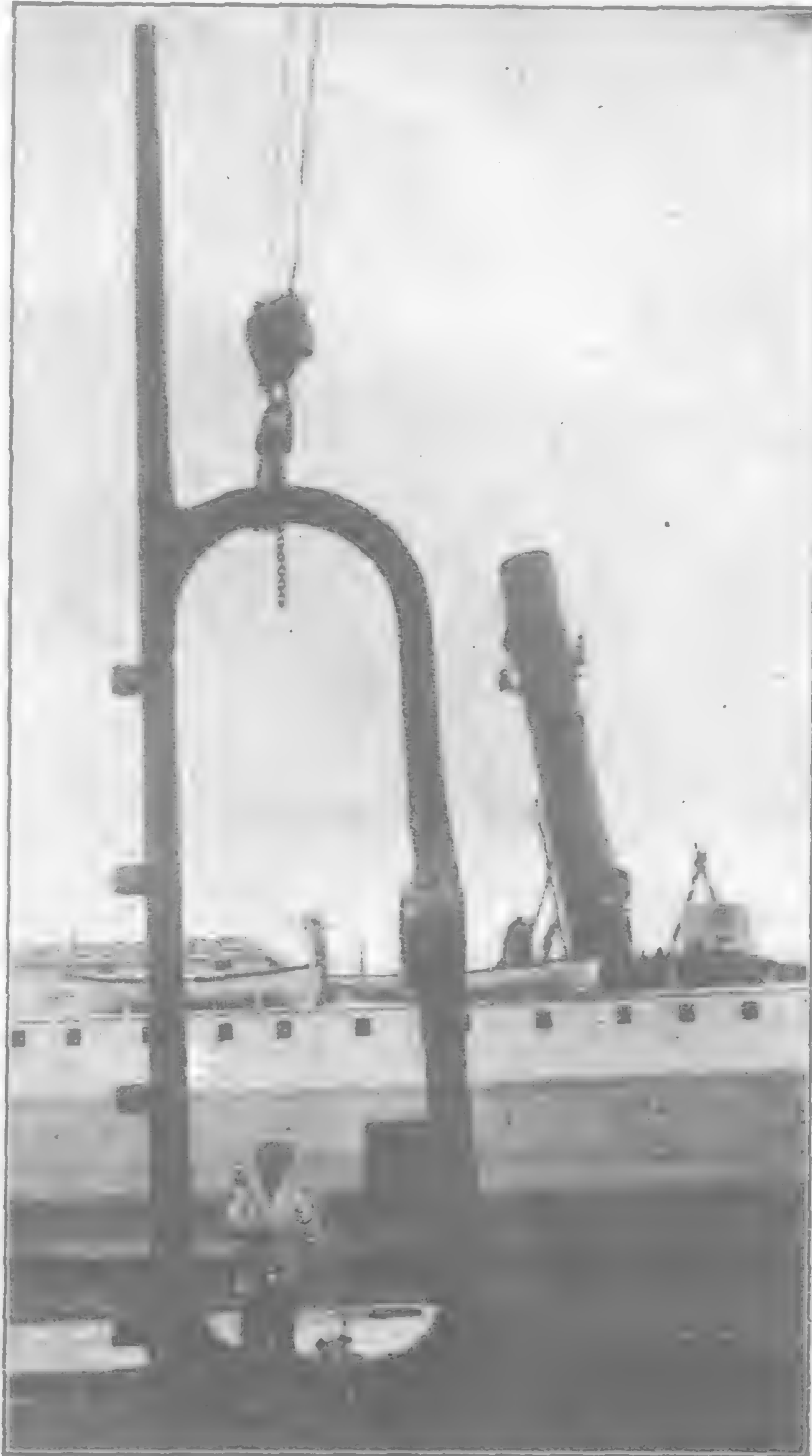
The Company owns the five dry docks here mentioned:

Names.	Length on Blocks	Breadth of Entrance	Depth on Sill at High Water
Cosmopolitan Dock.....	532 ft.	77 ft.	24 ft.
International Dock.....	528 ft.	77 ft.	23 ft.
New Dock.....	450 ft.	74 ft.	21 ft.
Old Dock.....	399 ft.	53 ft.	16 ft.
Tunkadoo Dock.....	355 ft.	67 ft.	16 ft.

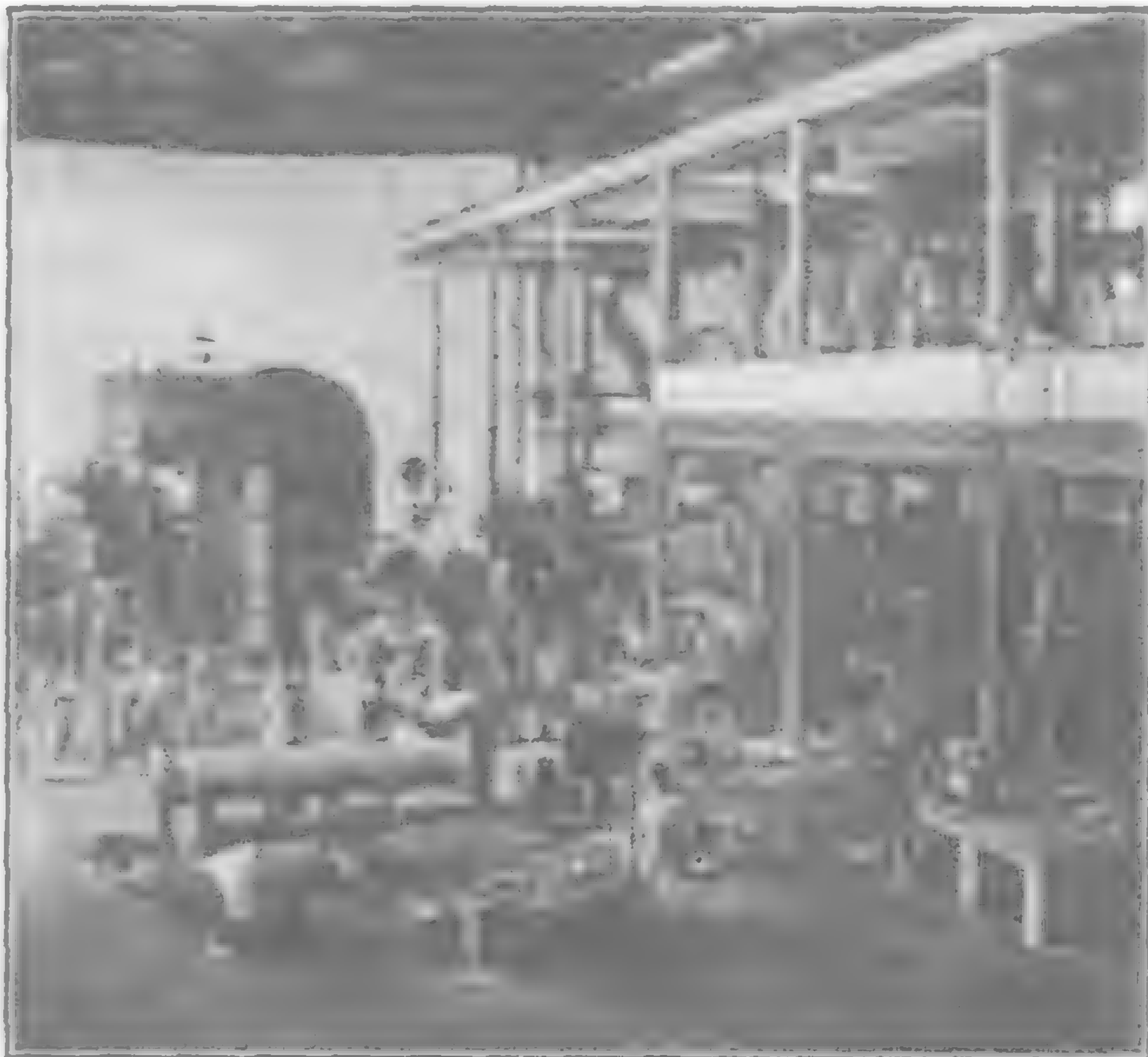
Two of these docks, which are placed at convenient angles to the river, are among the largest in the East, and capable of docking vessels up to 530 ft. in length; the conjoined water frontage is 4,465 feet, with deep water



ENGINES OF S. S. "WAN CHUN"



STERN FRAME FOR C. M. S. N. CO.'S S. S. "TOO NAN"



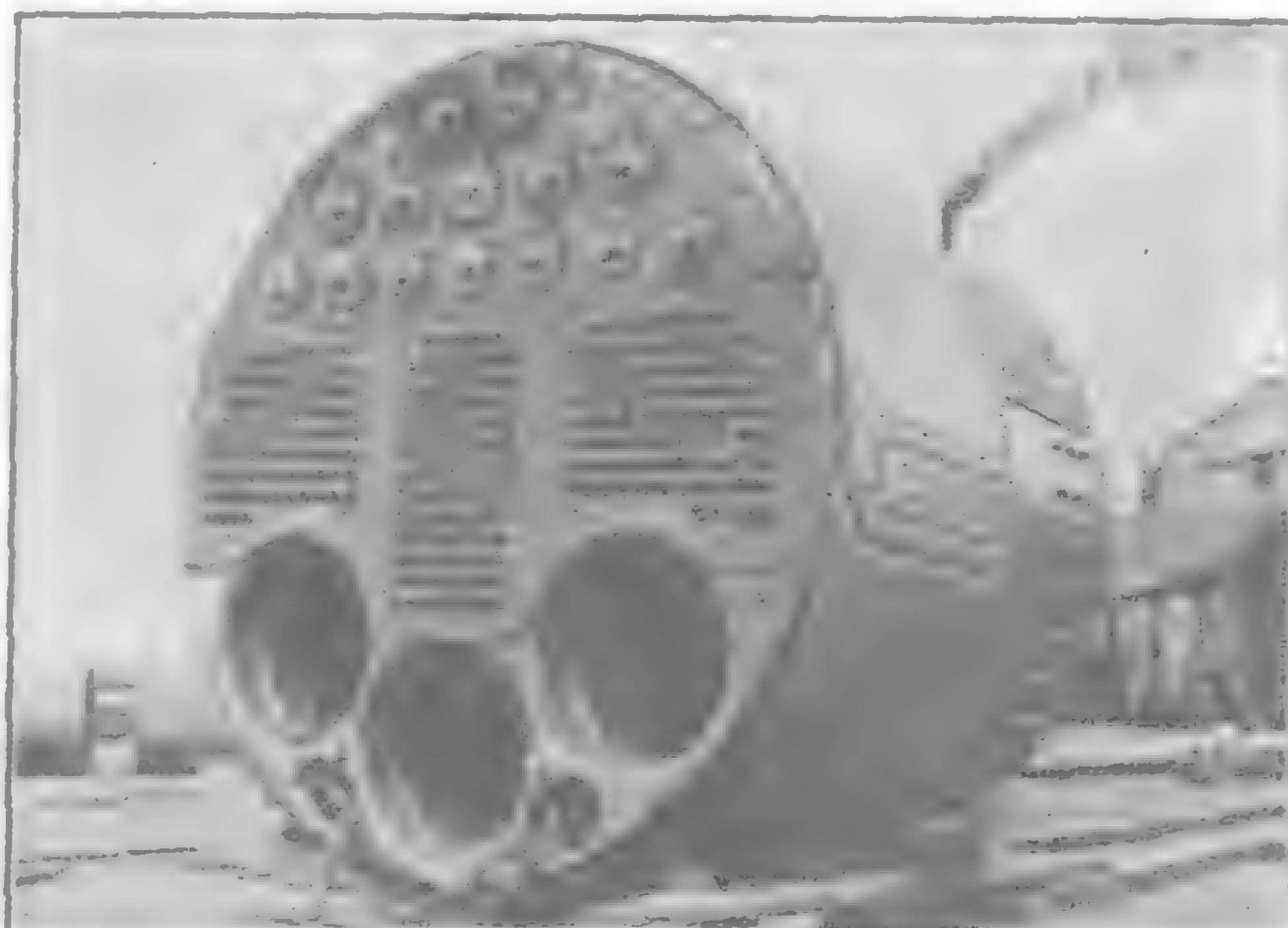
CORNER OF ONE OF THE MACHINE SHOPS OF THE SHANGHAI DOCK & ENG. CO., LTD.



SETTLING TANK FOR CHAPEI WATERWORKS  
30' DIAMETER X 22' HIGH

the whole length. Large buildings afford ample room for housing crews, and storing material.

Shear Legs capable of lifting up to 65 tons

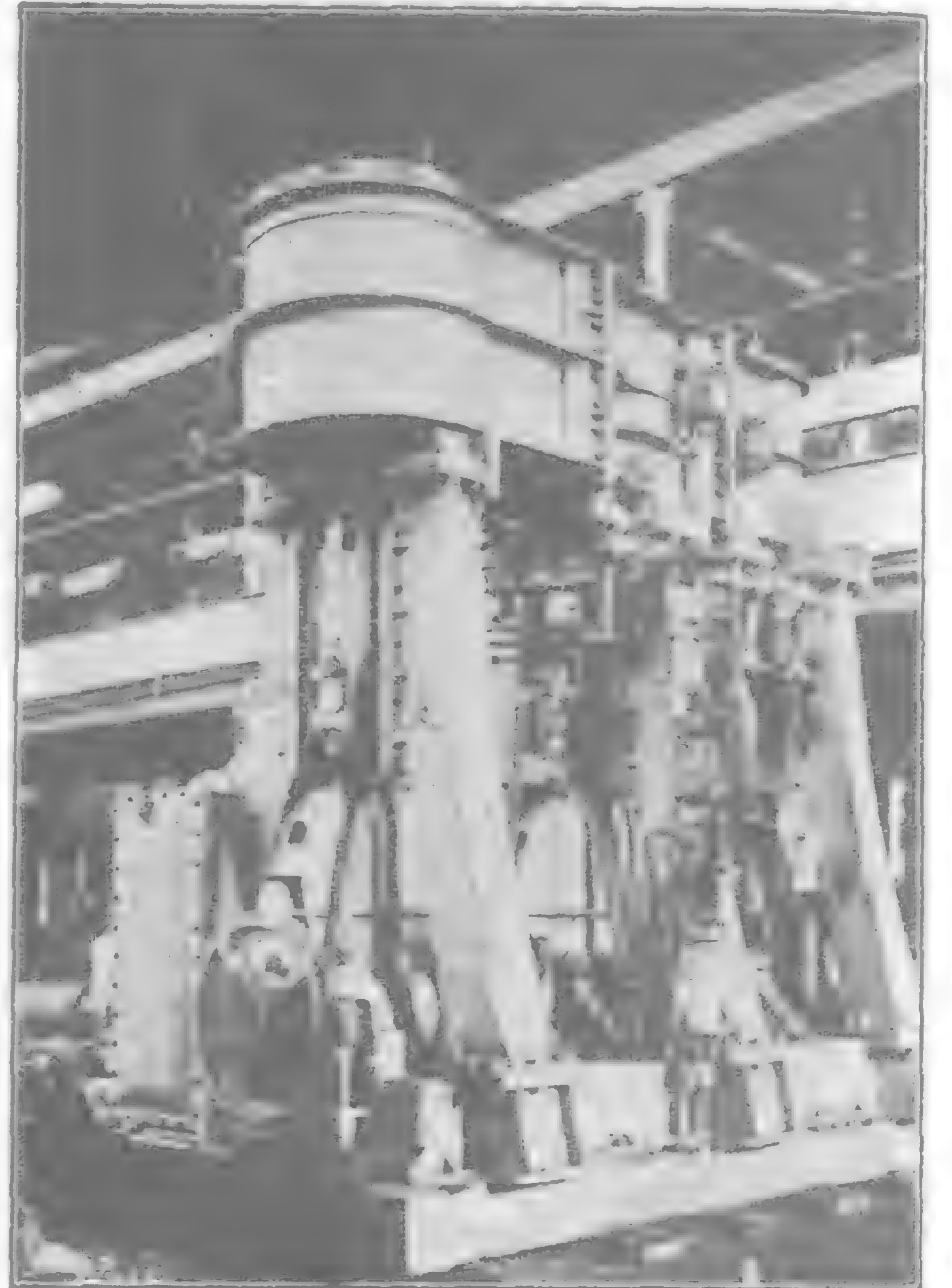


BOILER FOR T. S. S. "BREMEN" DIAM. 12' 3" X LENGTH 11' W. P. 190 LBS.

are placed at the various Docks and are available on short notice.

The shipbuilding yards face the river, and berths for building steamers of all sizes are laid out, together with slips for hauling up smaller craft.

There are extensive workshops, with all the latest improved tools, hydraulic and pneu-



ENGINES OF S. S. "WAN CHUN." TRIPLE  
EXPANSION SURFACE CONDENSING  
16"-26"-43" W. P. 180 LBS.  
30"  
TOTAL I. H. P., 900



H. I. J. M. "SUMIDA" BEFORE LAUNCHING

matic machinery, and travelling cranes of 60 tons' capacity.

Powerful salvage appliances are always ready for any emergency.

The docks and shops are lighted by electricity to facilitate night work and steamers under repair can have electric light supplied. Light railways for the quick handling of machinery run through the workshops and yards.

A large and experienced European staff of draughtsmen, shipbuilders, engineers, boiler-makers, etc., provide adequately for the efficient carrying out of all work entrusted to the Company, and when required, afford every assistance to prospective clients, in designing or selecting the particular article most adapted to their requirements.

The central works on the Pootung side of the Whangpoo River cover an area of 16 acres, having about 700 feet of water frontage, and the usual workshops of an up to date concern. A marine railway for hauling small craft up to 300 tons deadweight and a railway for conveying heavy weights from wharf to shops or elsewhere about the yard, together with shear legs of 35 tons capacity are also available

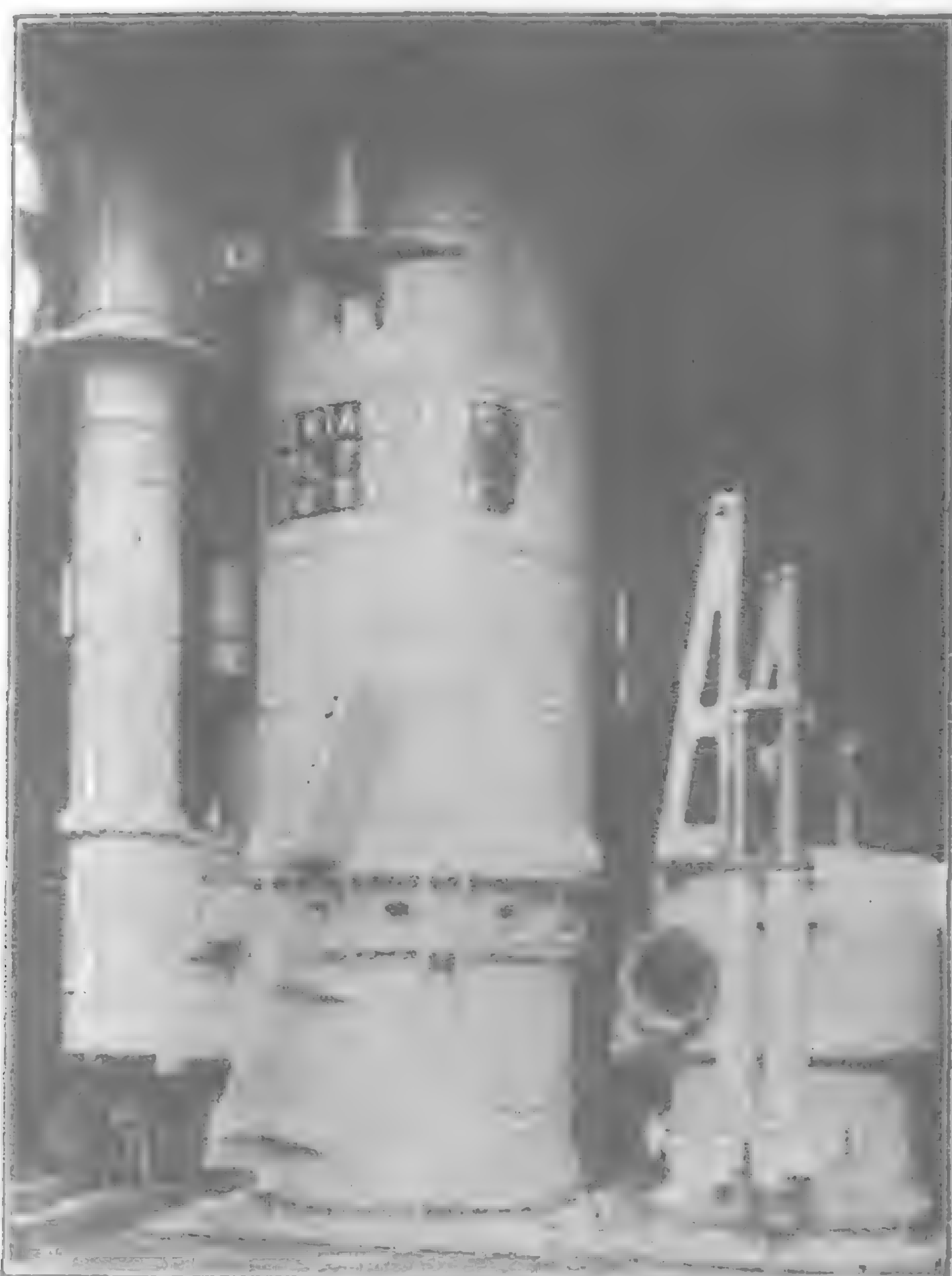




CHINA MERCHANTS' S. N. CO.'S STEEL SCREW STEAMER "HSINKONG"



ENGINES OF S. S. "KIANG HSIN" I. H. P. 3000



CYLINDER FOR S. S. "KIANG FOO." HEAVIEST CASTING MADE IN SHANGHAI, WEIGHING 13 TONS 15 CWTs.



NORDDEUTSCHER LLOYD TENDER "BREMEN" BUILT BY THE SHANGHAI DOCK AND ENGINEERING COMPANY



STEEL STORAGE VESSEL "NANKING" 165' X 35' X 11' M. L. D.



CHINA MERCHANTS' S. N. CO.'S S. S. "HSIN KONG" 270' X 40' X 21'6"—GROSS TONNAGE 2146; I. H. P. 1281

The godowns contain stores for building and fully equipping vessels of every class and size, and expeditiously completing repairs of every description, and are all-conveniently adjacent. Offices, docks and workshops are in direct telephonic communication with each other. The electrical department undertakes the

installing and wiring of light and power plants, building small dynamos, rewiring old ones, and electrical repairs generally.

The Company does not confine its operations to marine engineering, but is also largely employed in structural steel and bridge work, hydraulic machinery and pumping plants,

electric lighting and steam and hot water heating installations.

Every department is under skilled European superintendence, a steam ferry running at regular intervals maintains communication between the various docks and works, and a fleet of launches enable foremen to continually visit and supervise the work proceeding afloat



# Views of the Works of the Shanghai Dock and Engineering Co., Ltd.



TUNKADOO DOCK: STERN WHEEL STEAMER "CHANG WO" UNDER REPAIRS



VIEW OF A VESSEL IN THE DOCK



COSMOPOLITAN DOCK



"KIANG HSIN'S RETURN-TUBE BOILERS



NEW DOCK



OLD DOCK



# VULCAN IRON WORKS, LTD., SHANGHAI

The engineering and shipbuilding business carried on by the Vulcan Ironworks, Ltd., was founded in 1905. The yard and works are conveniently situated at Yangtszepoo, on the north bank of the Whangpoo, and can be approached by river and road. The property embraces an area of rather more than 37 mow of land—a little over six acres—and has a river frontage of 360 feet. About half this area is covered by offices, workshops, and storage godowns. Few concerns of the kind in the Settlement have a heavier or more up-to-date plant, the latest labor-saving devices having been installed. The whole of the plant is motor-driven, power being generated by duplicate sets of 75-kilowatt dynamos, each giving 340 amperes at a pressure of 220 volts. These sets are run on alternate days. The dynamos are direct-driven by engines running at 550 revolutions per minute.

The scope of the works may best be illustrated by a detail sketch of the various departments. The general and drawing offices are spacious, well-lighted apartments, surrounded by wide verandahs. The building is two storeyed, and measures 100 feet long by 62 feet wide.

In the pattern-makers' shop, which is 80 feet long by 50 feet wide, are band and circular saws, planing machines, and lathes, grouped on a 25 horse-power motor, together with a modern mitreing machine.

The foundry is 204 feet long by 63 feet wide. A travelling crane of 15 tons' capacity has been erected. Castings up to ten tons can be made, the cupolas employed being of the Thwaites rapid pattern—one of 5 and the other of 2 tons' capacity—with blast from a Root's blower.

The machine shop, which is 175 feet long by 60 feet wide, contains a large chuck-lathe of 15 feet diameter; lateral lathes so arranged that, by combining two of them, a piece of work 30 feet in length can be taken; shaping, planing, drilling, slotting, shearing, and screw-cutting machines; a band saw for iron, and other machines, some of which are grouped, while others are geared independently to motors. Overhead runs a travelling crane of 5 tons' capacity by Craven Brothers.

The blacksmiths' shop, 100 feet long by 52 feet wide, contains fourteen fires supplied with blast by independent Root's blowers, and is fitted with two steam hammers by Massey, one being of 30 cwt. and the other of 10 cwt. In the coppersmiths' shop, which is 45 feet long by 52 feet wide, a complete plant has been installed, consisting of two drilling machines, a hydraulic pipe bender, rolls, punching and shearing machines, etc.

The largest machinery in the works is that located in the boiler shop. This building is 175 feet long by 85 feet wide. In it there are four

punching and shearing machines, two large drills, two counter-sinking machines, one plate-edge planing machine, a set of heavy rolls for bending plates, and a machine known as a "mangle" for straightening plates. There is also a hydraulic plant, the accumulator being charged by means of a motor-driven three-throw pump. The power is applied to a large, fixed riveter, with 9 feet gap (on Tweddle's system, by the well-known firm of Fielding & Platt, of Gloucester), two portable riveters, for dock, bridge, and guider work; a hydraulic flanging machine, with arrangements for flanging Lancashire boiler flues; and two 4-ton hydraulic cranes, built by the Vulcan Ironworks.

Besides these shops there is a moulding loft, 140 feet long by 50 feet wide, and a carpenters' shop immediately beneath, with motor-driven machinery of all descriptions, whilst to facilitate

repairs to small vessels of about 100 feet in length a patent slip has been laid down, equipped with motor-driven hauling gear manufactured by the firm.

The Vulcan Ironworks have constructed a creditable number of vessels of all descriptions, including steel and wooden lighters, pontoons, and pontoon-hulks, tugs, passenger tenders, steam and motor launches, etc., ranging in length from 20 feet to 250 feet. In addition to these, all kinds of fitting-out and repair work have been executed to ocean-going vessels calling at the port, and installations, overhauling, and general repairs have been carried out in the many factories and mills in and around this busy and industrious centre by skilled native labor under competent European supervision. Railway cars and coaches have been erected for various Chinese roads.



MOTOR LAUNCH "SUMATRA" BUILT BY THE VULCAN IRON WORKS LTD. OF SHANGHAI FOR THE ASIATIC PETROLEUM CO. LD.—DIMENSIONS, LENGTH 66'-0" OVERALL, BREADTH 11'-0", DEPTH 5'-3", DRAUGHT 4'-3".



LAUNCH BUILDING SHED AT VULCAN IRON WORKS





MOTOR LAUNCH "VACUUM" BUILT BY THE VULCAN IRON WORKS, LTD.

### THE YANGTZE ENGINEERING WORKS, LTD., HANKOW

The Yangtze Engineering Works, Ltd., a company capitalized and managed by Chinese, was established in 1907 with its Head Office in the German Concession, Hankow. The works, situated at the Seven Mile Creek, command a prominent position on the lower reach of the Yangtze River. They cover an area of about 30 acres of ground, and a further extension at the back of the present works, where another larger piece of land fronting the creek has been acquired and reserved for the purpose, is contemplated.

The main feature of the works is the bridge-building shop, which is well equipped with the most modern machinery for this class of work. Among the machine tools installed in this workshop may be noted a Patent Powerful Four roller and Mangles, Long Plate Edge Planers, Radial Drills, Girder Ending Machine, besides a full equipment of Punches, Shears, Cold Saws, Bending Presses, Riveters, Blowers, Furnaces and complete Hydraulic and Pneumatic Plants, while the handling of material is done by a powerful Electric Overhead Travelling Crane and Jib Cranes. The iron building is spacious, and is well arranged in the matter of light and ventilation.



THE LAUNCH "SUMATRA" ON THE WAYS



STEEL PONTOONS EIGHT DAYS AFTER CONTRACT AT THE VULCAN IRON WORKS LTD.





MOTOR LAUNCHES BUILT BY THE VULCAN IRON WORKS, LTD., SHANGHAI



GENERAL VIEW OF THE VULCAN IRON WORKS AT SHANGHAI

The office, the store, the fitting and machine shops, the point and crossings shop, the smithy and the foundry are, for convenience, arranged in a row, practically under one extensive roof, and are equipped with lathes, drilling, screwing machines, rail planers and sharpeners—the last specially adapted for dealing with points and crossings, of the latest patterns and imported from well-known English makers. The buildings of these shops were constructed of iron materials supplied by the Hanyang Iron and Steel Works.

All the machine tools are driven by electricity, the generating plant and motors having been supplied by the Lancashire Dynamo and Motor Co., while the gas suction plant was made by Crossley Bros. of Manchester. The power plant also supplies electric lighting throughout the works.

A loft with joiner's shop attached is erected at a little distance from the machine shops, in which patterns and templates are made.

The special lines, besides shipbuilding and general engineering work, in which the Yangtze Engineering Works possess exceptionally good facilities for handling, are bridge-building and making points and crossings.

The management aims at making the works thoroughly efficient and up-to-date in every respect, and is confident that they will occupy a place in the front rank of engineering concerns in China.

The Directors are Mr. V. K. Lee, General Manager of the Hanyang Iron and Steel Works, Mr. Lo Hung-chang, Manager of the Board of Communications Bank, and Mr. Sung Wei-chen, Manager of the Hankow Waterworks and Electric Light Co. The General Manager is Mr. Wong Kwong, M.I.N.A., M.I.S. Inst., and the staff, which is quite a large one, is composed wholly of Chinese with the exception of Mr. G. W. Cockburn, who is in charge of the Bridge Department. The latter gentleman is an English bridge engineer and designer of good experience and standing, having been for a number of years with Messrs. Head, Wrightson and Co., Ltd., the Cleveland Bridge Co. and other well-known bridge building firms.

Mr. Wong Kwong, the General Manager, is the only Chinese gentleman, who has been awarded the degree of M.I.N.A., M.I.S. Inst.

During 1909 they turned out one large steel tug and a good number of lighters, points, and crossings; they also executed a large amount



THE HAN SHUN UNDER WAY



VIEWS OF THE STEAM TUG HAN SHUN BUILT BY THE YANGTZE ENGINEERING WORKS FOR THE HANYANG IRON &amp; STEEL WORKS

of steel structural work and extensive repairs to steamers, tugs, and launches. The orders booked have necessitated the installation of an additional plant and the extension of the works in every way.

The Steam Tug "Han Shun" is a steel vessel, 120' 0" long by 21' 0" beam by 12' 0" deep, propelled by one set of Compound Surface Condensing Engines with an indicated Horse Power of about 500. Her boiler is of the Cylindrical Multitubular type constructed to Board of Trade Rules for a working pressure of 120 lbs.

per square inch. The Han Shun is specially designed and strongly built for towing purposes, her speed when light being 11 knots and with a tow of 1,000 tons, 7 miles per hour. The vessel has been running satisfactorily since the 15th March, 1910, when she was handed over by the builders, The Yangtze Engineering Works, Hankow, to the owners, The Hanyang Iron & Steel Works, Hanyang. The designer is the General Manager of the Yangtze Engineering Works, Mr. Wong Kwong, M. I. N. A., M. I. Mech. E., etc.



# NEW ENGINEERING & SHIPBUILDING WORKS, LTD., SHANGHAI

This enterprise has forged to the front as one of the leading shipbuilding and dockyard establishments of the Orient. Founded in 1900 as a limited liability company under the Hongkong Ordinances, the shares were taken up privately and are still so held. Messrs. Arnhold, Karberg & Co. are the general managers of the company and so

saw-mills, cotton mills, cigarette factories, etc., and erected tanks at Chingkiang, Tongku, and Hangchow for the Shell Company, as well as six large oil tanks for the Standard Oil Company—three of them at Shanghai, measuring 80 feet each in diameter, and 25 feet in height, and three at Hankow measuring 70 feet each in diameter. The

In 1908 work was commenced on a drydock so as to enable the company to compete for and secure its share of the larger marine repair contracts. Profiting by the experience gained in building other docks in Shanghai the work of construction was pushed ahead without any serious delays or handicaps and completed in twelve months.



GENERAL VIEW OF THE YANGTSZEP00 DOCK, SHANGHAI.—S. S. INDRAMAYO, 5200 TONS, IN DRYDOCK, 410 FEET LONG

successful have been its operations that the extensive additions to the original plant, including the great expense of constructing a drydock, have been paid for out of the earnings. These works situated on Yangtszepoo Road, with a deep sea frontage on the Whangpoo River, are equipped with hydraulic riveting machinery, pneumatic tools and electric drills for the quick execution of repair work, and an up-to-date plant in each of the various shops.

Since commencing operations the company has built over 150 vessels in steel and teak-wood, ranging from five to 500 tons each. Forty of these were steam vessels with an aggregate of 4,000 horse-power. The firm makes a specialty of light draught vessels, tug-boats, and lighters, and has been very successful with light draught tow-boats of the hollow stern type, some of which are now in constant employment at Hankow and Chefoo. It has constructed a large number of pleasure craft, for which the demand in Shanghai is growing. In the engineering shops the firm has constructed machinery aggregating 1,200 indicated horse-power for

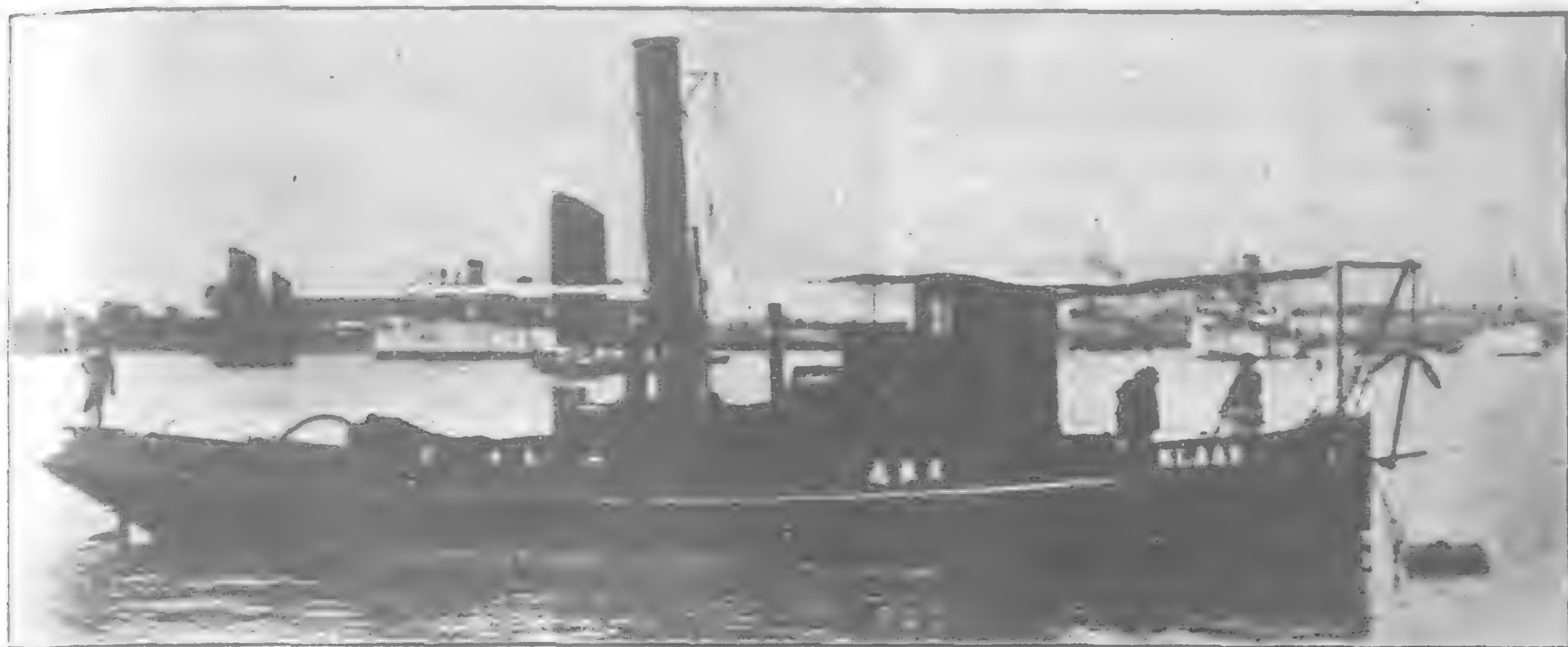
orders for the boilers of American type, for the Shanghai and Hankow installations, were also entrusted to the firm. At the close of the Russo-Japanese War, the Company adapted five large vessels for the transport of troops. Each was fitted with bunks, officers' quarters, hospital accommodation, cooking ovens, and bathing appliances for a large number of men, the average number carried by each steamer being 2,000. Altogether some 500 men are constantly employed in the works.

The principal dimensions of the Yangtszepoo Dock are as follows: length on blocks 452 ft.; width of entrance—bottom 60 ft.; coping 70 ft.; depth to floor, 27 ft.; depth of water at ordinary spring tides on 3 ft. blocks, 19 ft. Work on the dock was begun on May 22, 1908. The interior consists of mud terraces and planks, and the entrance is closed by a steel caisson, the only one of its kind in Shanghai. This caisson is equipped with electrical pumps, which are operated by



VIEW OF DOCK AND WORKS FROM THE RIVER.—S. S. INDRAVELLI JUST OUT OF DOCK; S. S. SIBIR ENTERING AND S. S. EIGER ALONGSIDE





TUGBOAT BUILT AND ENGINED BY THE NEW ENGINEERING AND SHIPPING WORKS, LTD.  
FOR THE EAST ASIATIC PETROLEUM CO.

It may be mentioned that the dock was constructed in the short space of twelve months from start to finish, a record in dock building in this part of the world. Since the opening, the dock has been very well patronized. Last autumn the company salvaged the S. S. "Proteus" which was badly ashore on the shifting sands at the delta of the Yangtze, the vessel was brought into dock where she was repaired and reclassified, the repairs included the renewal of the stern frame, stern tube, rudder and propeller, also a number of plates, etc.

Sheerlegs are being erected which will be capable of handling weights of 60 tons. The works have a river frontage of 830 feet with an ample depth of water alongside for accommodating vessels which visit the port.

The organizer of the works and designer of the dry dock is Mr. John Blechynden,



ONE OF TEN UP RIVER LIGHTERS AFTER LAUNCHING



TWO OF TEN LIGHTERS FOR UP RIVER SERVICE



CHINESE CRUISER JUST PREVIOUS TO DEPARTURE FOR NORTHERN WATERS



PART OF SHIPYARD



LIGHT DRAUGHT TOWBOAT HOLLOW STERN TYPE FOR UP RIVER SERVICE



TENDER YENTAI BUILT BY THE NEW ENGINEERING WORKS FOR THE CHINA NAVIGATION CO. FOR SERVICE AT CHEFOO

connexions with water-tight plugs on either side of the entrance. The caisson floats in 9 ft. of water, and as there are always 12 ft. on the blocks, the dock can be opened at shorter notice than any other in Shanghai.

The pumps for emptying the dock have been constructed on the premises and are placed in an engine-house on the west side. They consist of two 22-inch centrifugal pumps driven by compound surface-condensing engines, and can discharge 18,000 gallons of water a minute. With a vessel of moderate size on the blocks the dock can be emptied in from two to two and a half hours.

It is the intention of the New Engineering and Shipbuilding Works to add sufficient new machinery, etc., to cope with every kind of work that comes its way. The sanitary accommodation for the use of the crews of vessels under repairs includes a bathroom with hot and cold water laid on, and electric light. Ships in dock can be supplied with electricity or steam, and besides an efficient fire service a tank has been installed which has a capacity of 70 tons of filtered water.



ANOTHER VIEW OF YANGTSEPOO DOCK

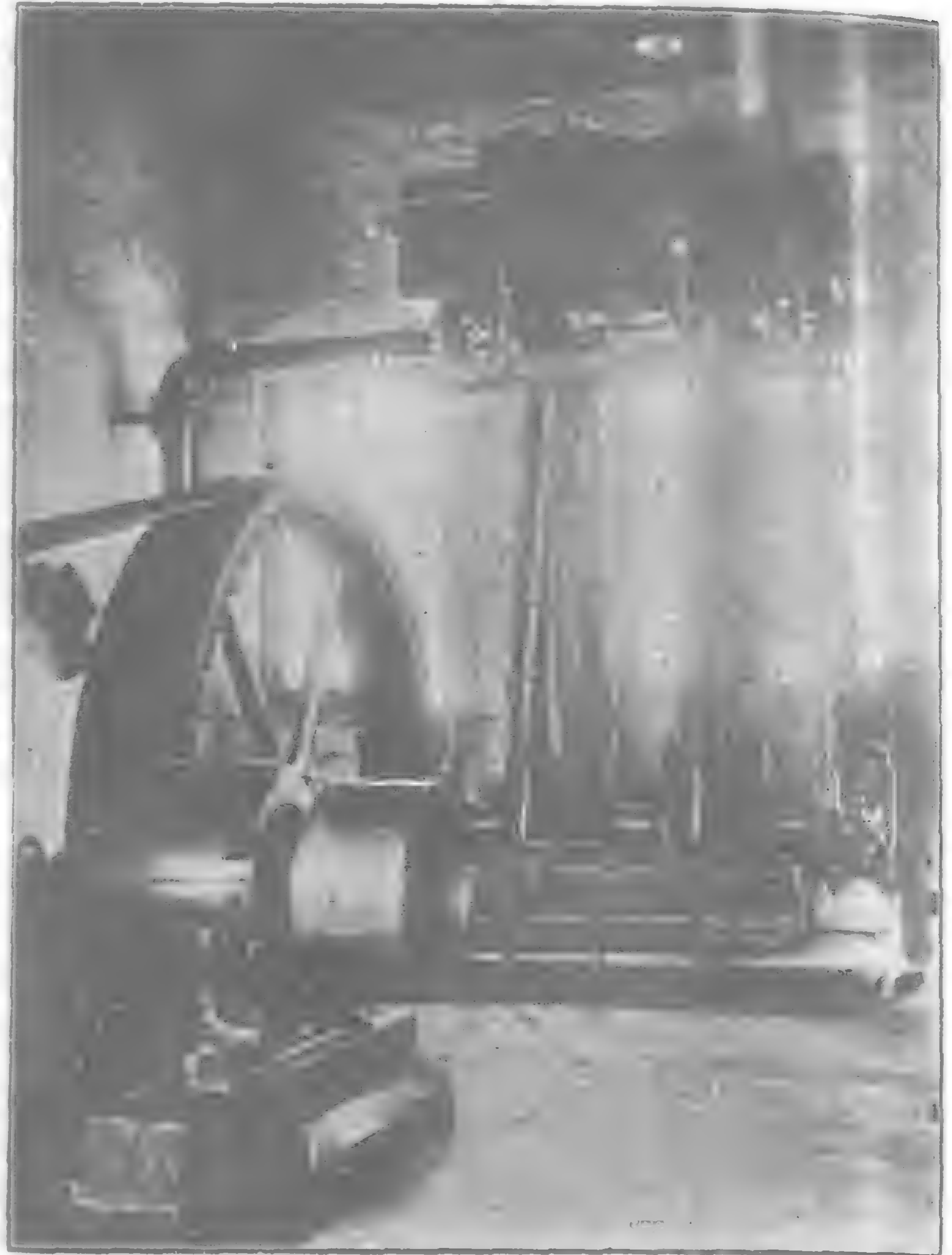


M. I. M. E., who still retains his connection with the firm.

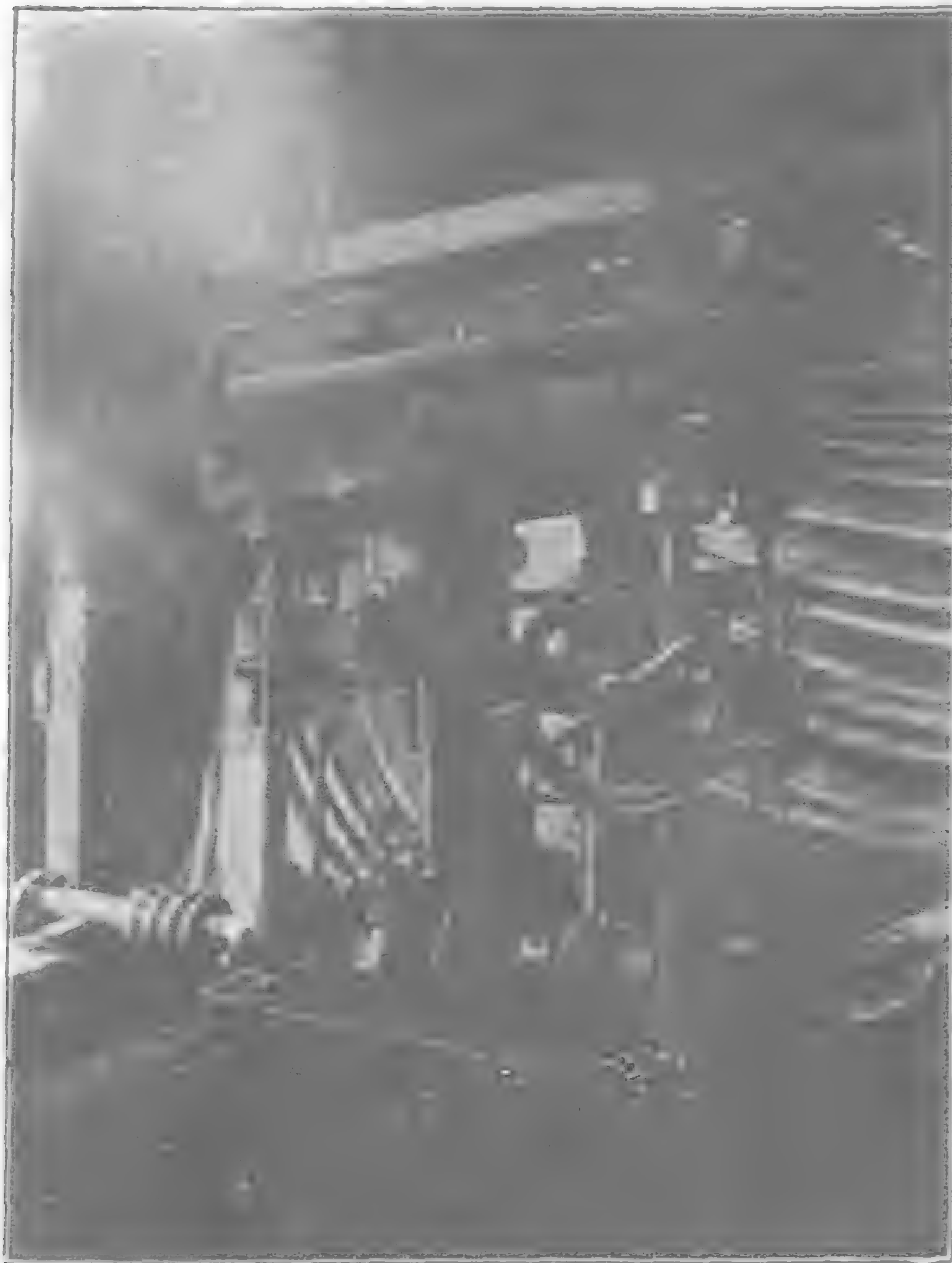
The New Engineering & Shipbuilding Works have also inaugurated a new departure in the form of a native sampan fitted with tanks for the purpose of transporting bulk oil. These tanks have a capacity each of 60 tons of oil and the craft is propelled by two motors of 50 b. h. p.

#### CHINA GENERAL ENGINEERING CO., SHANGHAI.

This company specializes in motors and motor boats, holding The Grei and Fairbanks Morse & Co.'s agencies for China. It has its own boat building works on Liziza Road by the side of the Foochow Creek, and it has successfully built over 100 motor launches destined for all parts of the Empire. Up in far Szechuan, in the Fungting Lake and as far north as Harborsk, their launches are plying the rivers of China. The Imperial Maritime Customs, and the Russian Government, give this firm an almost exclusive monopoly of their motor boat trade. The manager, Mr. O. Jansen, C. E., has a wide experience in motor boat work.



COMPOUND ENGINE FOR SAWMILL BUILT AND ERECTED BY THE NEW ENGINEERING WORKS



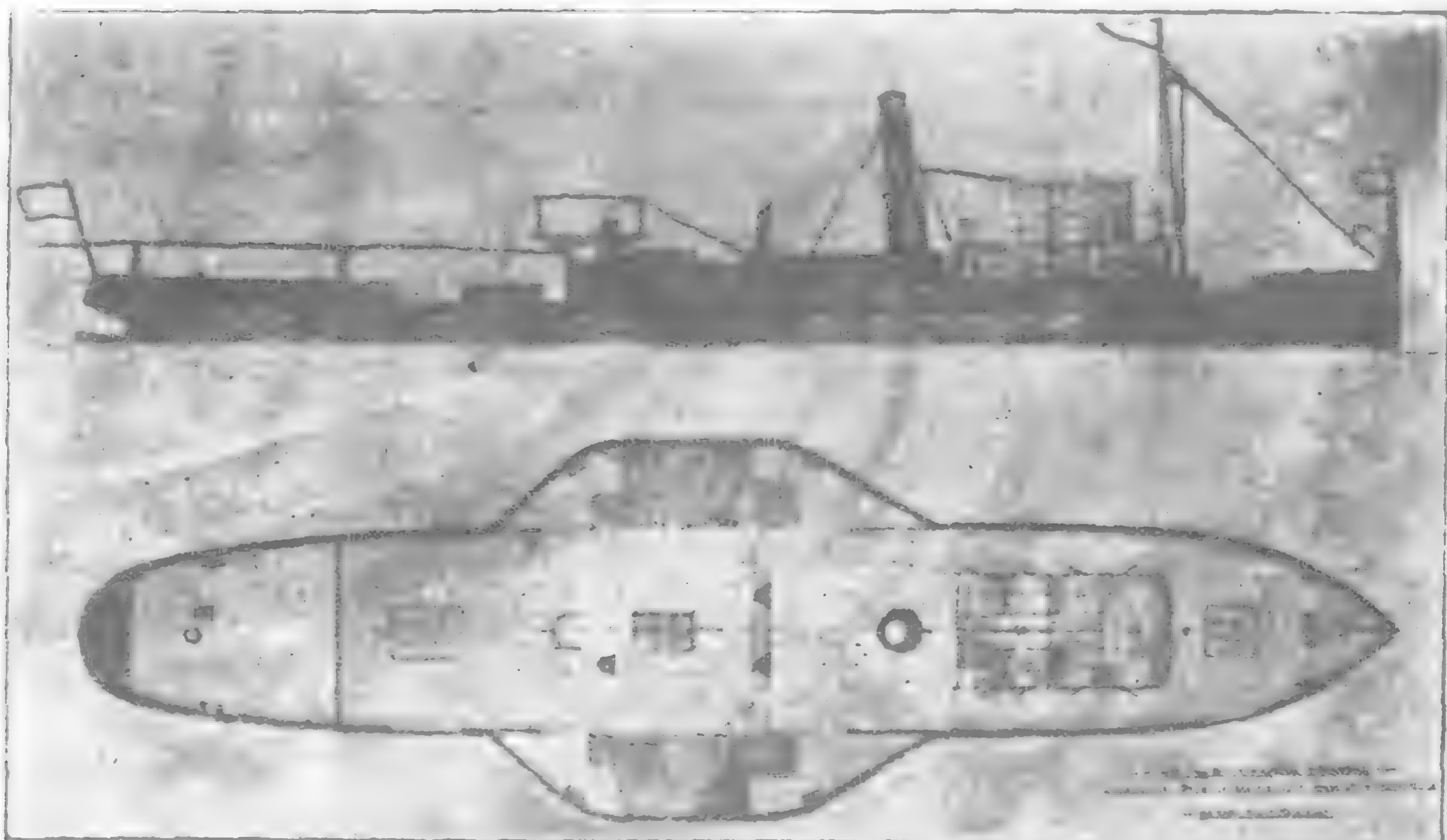
COMPOUND MARINE ENGINES BUILT BY THE NEW ENGINEERING AND SHIPBUILDING WORKS



PART OF MACHINE SHOP OF THE NEW ENGINEERING AND SHIPBUILDING WORKS



ENTRANCE TO THE WORKS ON YANGTSZEPPOO ROAD, SHANGHAI



PLAN OF PADDLE STEAMERS 150 FEET LONG BUILT AND ENGINED BY THE NEW ENGINEERING AND SHIPBUILDING WORKS, LTD.



RUSSIAN VOLUNTIER FLEET STEAMER YARASLAV IN DRY DOCK



THE HONGKONG AND WHAMPOA DOCK CO., LTD., OF HONGKONG

The Hongkong and Whampoa Dock Co., Ltd., was established in 1863 and is one of the leading shipbuilding establishments in the Far East. The company has a most extensive plant and engages in shipbuilding, marine and land en-

gineering, iron and brass founders work, forging, electrical construction, railway supplies, etc. The head office is located at the Kowloon Dock and the Town Office in Queen's Building, Hongkong.

The Company has six granite dry docks and two patent slipways which are situated at their three establishments at Hunghom, Tai-Kok-Tsui and Aberdeen. Their dimensions are as follows:







PASSENGER COACHES BUILT BY THE HONGKONG & WHAMPOA DOCK CO., LTD., FOR THE BRITISH SECTION OF THE KOWLOON-CANTON RAILWAY

Name of Dock or Slip.	Length on Keel Blocks.	Entrance Breadth.	Depth over Sill at ordinary Tides.	Rise of Tide.	Neaps.
	Feet.	Feet.	Feet.	Feet.	Feet.
"Kowloon."					
No. 1 Dock	700.	86 ft. top 70 bottom	30	7' 6"	3
No. 2 Dock	371	74	18' 6"	7' 6"	
No. 3 Dock	264	49' 3"	14	7' 6"	
No. 1 Pat. Slip	240	60	14	7' 6"	
No. 2 Pat. Slip	220	60	12	7' 6"	
"Tai-Kok-Tsui."					
Cosmopolitan Dock	466	85' 6"	20	7' 6"	
"Aberdeen."					
Hope Dock	430	84	23	7' 6"	
Lamont Dock	333	64	16	7' 6"	

The principal works are at Hunghom on the Kowloon side of the Harbour, distant about two miles from the City of Victoria, and among some of its chief points of interest may be mentioned:—

**Machine Fitting and Erecting Shop**—Three Bays, each 272' 0" X 52' 0", containing together two 10-ton electric overhead travelling cranes, one of 15-tons and two of 20-tons. The shop is equipped with a complete plant of up-to-date high speed machine tools of every description capable of turning out work of the heaviest class with expedition. Among the principal tools may be mentioned the following: **Longest Lathe** can take 75' 0" between centres, height of centres from top of shears 27", motor driven.

**Largest Chuck Lathe** can take 10' 0" diameter in chuck, motor driven.

**Lathe** for heavy turning with high speed tools can take 21' 0" between centres; height of centres 21" motor driven.

**Largest Planing Machine**, 8 feet between housings, can clear 8' 0" high from table, length of stroke 20' 0" motor driven.

**Largest Milling Machine**, can machine 5' 0" above table, width between housings 5' 0". Table 12' 0" X 5' 0", traverse of table 12' 0".

**Largest Slotting Machine**, 27 inches stroke, motor driven.

**Wall Planer**, to plane 12' 0" vertically and 12' 0" horizontally, motor driven.

**Largest Boring Machine**, suitable for cylinders up to 5' 0" diameter by 9' 0" long.

**Boiler Shop**.—One Bay 262' 0" X 62' 0" contains one 30-ton overhead electric travelling crane and one hydraulic rivetter.

One Bay 262' 0" X 42' 0" contains one 40-ton overhead electric travelling crane and one 10-ton overhead rope driven crane with one largest size hydraulic rivetter, drilling and screwing machines, etc.

**Boiler Shop Smithy**.—Two Bays, each 121' 0" X 30' 0" containing 28 fires and two 8-cwt. steam hammers.

**Shipyard and Boiler Shop Machine Shed**.—This shed comprises four bays, each 262' 0" X 30' 0", containing punching and shearing machines, light and heavy rolls, machine for rolling angle frames, plate edge planes, drilling machines, hydraulic flanging press, hydraulic manhole punch, hydraulic keel plate bender, hand overhead cranes, emery wheels, grindstones, etc.; also one bay 209' 0" X 56' 0" containing angle bar cutting machine and punch and 17 angle smith's fires and one bay 139' 0" X 42' 0" containing large rolls suitable for plates 30' 0" wide, and overhead hand cranes.

The ship building yard which adjoins has a frontage of 570 feet and will admit of ships 500 feet in length being laid down. The position is well protected, and there is deep water for launching ships with safety.

**Blacksmith Shop**.—This department comprises three bays, each 195' 0" X 50' 0" containing 48 ordinary smith's fires, one furnace for 1-ton hammer, six 8-cwt. steam hammers, one 1-ton steam hammer, four bolt, nut and rivet making machines and furnaces, radial drills, screwing machines, etc.

**Forge**.—160' 0" X 82' 0" with three furnaces, one to suit each size steam hammer. The largest hammer is 10 tons, suitable for heaviest marine shafting work, etc., and there are two 2-ton hammers with steam cranes to each. There are two open hearth smith's fires. The company can handle and make forgings up to 20 tons, the largest propeller shaft forged being about 10 tons and the heaviest stern frame, about 8 tons.

**Foundry**.—This department comprises one bay 54' 0" X 43' 0", three cupolas for cast iron, 3 steam cranes, and one 2-ton air furnace for brass.

One bay 48' 0" X 43' 0" with brass furnace, white metal furnace, overhead cranes, etc.

One bay 60' 0" X 57' 0" with one 10-ton steam crane, gear wheel moulding machine, oil furnace for melting brass, etc., capacity 500 lbs.

The largest cylinder cast is 10 tons, the largest propeller 18' 0" diameter, 8 tons, cast iron, the heaviest bronze propeller blades 3½ tons each and the longest liner cast, 25' 0" in one length.

The heaviest casting turned out is an anvil block for 10-ton steam hammer representing 100 tons of cast iron.

The greatest monthly output was 130 tons cast iron and 7 tons brass.

**Sawmill and Joiner Shop**.—The sawmill and joiner shop is completely equipped with a large plant of all descriptions of steam driven saws and wood working tools of most modern and improved design.

The extensive carpenter shops and boat building sheds adjoin the saw mill.

**Steam Shears**.—Powerful steam shears 80 feet high and capable of lifting 75 tons, stand on a granite wharf with deep waterfrontage.

**Railway Lines** are laid throughout the yard to the various departments enabling gear and materials to be transported with convenience and expedition.

**Electric Light** is installed in all the shops, the yard and around the docks, admitting of work on ships being carried on at night. Current can be supplied to ships lying in dock or alongside.

**The Galvanizing Plant** by electrical deposit is of the most improved type and is capable of taking plates 20' 0" X 9' 0".

The Company's **Stores** carry a heavy stock of all descriptions of steel, iron, and timber for shipbuilding or repairing, engine and boiler fittings, etc., all of the best quality, which are supplied at reasonable rates and delivered with despatch.

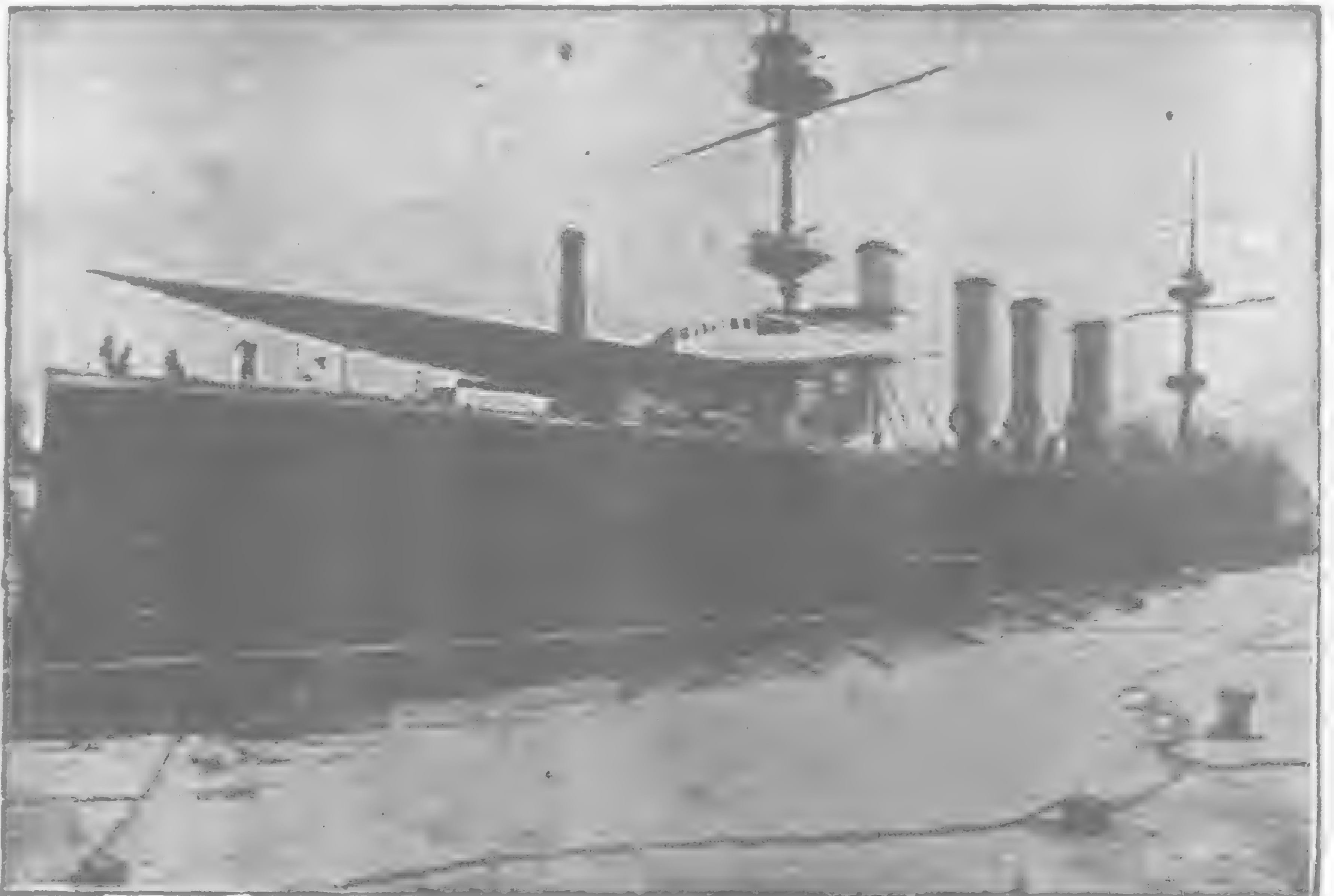
**Compressed Air Plant**.—The works are equipped with a complete installation of compressed air tools in the way of rivetters, hammers, drills, chippers, etc.

**Salvage Steamer**.—The twin screw salvage steamer *David Gillies* is fully equipped with a complete plant of powerful salvage gear and tools and on call can be despatched at a moment's notice. In addition, the Company has on hand a number of large and small centrifugal wrecking pumps, diving gear and other salvage appliances, all in readiness for shipment without delay.

**Steam Launches**.—The company's large fleet of fine steam launches is always in readiness to attend on ships in the harbour, for conveyance of workmen, material, etc.

**Cosmopolitan Dock**.—The Cosmopolitan Dock is also on the Kowloon side of the harbor and is situated at Tai-Kok-Tsui in a well sheltered position and distant about two miles from Victoria. The dock, which is built of granite, can accommodate ships up to 450' 0" X 53' 0" X 21' 0" draft. The workshops possess every facility and appliance necessary for efficient and prompt repairs to ships or machinery.

**Aberdeen Docks**.—The Aberdeen Docks are situated at the head of an inlet on the South



H. M. S. POWERFUL IN NO. 1 DOCK, KOWLOON.



# THE TAIKOO DOCKYARD & ENGINEERING CO. OF HONGKONG, LTD., HONGKONG



TAIKOO DOCKYARD & ENGINEERING CO. OF HONGKONG: GENERAL VIEW OF DOCKS AND SLIPWAYS

The Taikoo Dockyard & Engineering Co. of Hongkong, Ltd., whose management is represented by the well known firm of Messrs. Butterfield & Swire is the latest addition to Far East Dockyard and Engineering establishments. Commenced in 1900 and first opened to public business at the end of 1908, it is now fully equipped with the most modern machinery and appliances for the whole range of constructional, docking and repair work.

The site, with its dry dock, slipways and workshops covers an area of 50 acres with magnificent water frontage and approach. The accommodation is ample for the largest vessels afloat in these waters, as an examination of the undernoted figures will show, and supplemented by a full technical staff and skilled foremen from the yards of Clyde and Tyneside it takes its stand amongst the leading enterprises of its kind in modern times.

The yard now actively competes for Far

Eastern business. It has the docking and repair work of the large fleet of China Navigation Co. steamers in its charge in addition to that of other well known companies trading on the adjacent coast of China and in Southern waters. The big Pacific liners of the Pacific Mail and Toyo Kisen Kaisha dock and repair there, and although the past two years have not been noticeable for marked activity in ship-

building construction, the company has secured a fair share of such work as has been offering.

*The Dock.*—Situated just inside the Lyee-moon Pass, the Northern and deeper entrance to the harbour, the Dock is conveniently placed for the full and free manoeuvring of ships prior to docking or repairing, being well clear of any congestion of shipping in the harbor.



THE S. S. UNION ON THE SLIP CUT AND DRAWN APART

side of the island of Hongkong. The entrance is safe and the anchorage good. The docks are substantially built throughout with granite.

The company is in a strong position to undertake all classes of constructional and general engineering work, also locomotives, railway rolling stock and plant, bridge work, etc. Extended experience and success in the building of coast and river steamers, tug boats, shallow draft vessels, stern wheelers and launches of all descriptions. A speciality made of high speed passenger and cargo motor boats. Defibrating, pulp, sugar and auxiliary machinery for land and marine purposes, pumps, etc., made with expedition. The plant throughout is of the most modern and up to date type. Docking and repairs effected with promptitude and at moderate charges. All classes of cocks, valves and other ships' fittings supplied at reasonable rates. A large and varied stock of steel and iron plates, bars, etc., always kept on hand.





U. S. S. HELENA ON NO. 2 SLIP AND U. S. GUNBOAT "SAMAR"



U. S. S. HELENA ON NO. 2 SLIP



T. S. S. "NIPPON MARU" IN DOCK



S. S. "CHIYO MARU" IN DOCK



T. S. S. "NIPPON MARU" IN GRAVING DOCK



S. S. "CHIYO MARU" IN DOCK





PLATER'S SHEDS



100-TON CRANE

## TAIKOO DOCKYARD &amp; ENGINEERING WORKS

The following are a few interesting facts concerning it:

It is built to British Admiralty requirements.

It is founded on a solid rock bottom, and built of cement concrete lined with granite throughout.

It can be filled in 45 minutes and pumped out in 2 hours and forty minutes.

Its dimensions are: 787 ft. extreme length, 750 ft. on the blocks, 120 ft. width at coping, 77' 6" width at bottom, 88 ft. width of entrance at top, 81' 0" width of entrance at bottom, 34' 6" depth over centre of cill at high water spring tides, 31' 0" depth over side of cill at high water spring tides.

**Caisson.**—A feature of the dock is the caisson which is of the new box sliding type, built by Messrs Hanna Donald & Wilson of Paisley.

It is electrically driven, and can be hauled from, and to its chamber across the sill in 4½ minutes.

A collapsible bridge is fitted to the top of the caisson which folds down automatically to allow the caisson to enter its chamber.

**The Dock Pumps.**—These consist of two sets of "Conqueror" parallel type, made by Messrs. W. H. Allen, Sons & Co., Ltd., of Bedford, having suction and discharge branches of 54 inches diameter, each driven by an electric

motor of 600 H. P., 2 sets of 54 inch sluice valves, with motors for operating, an electrically driven air pump for charging same, and a 10" drainage pump.

## THE SLIPWAYS.

**The No. 1 Slipway.**—This is 1,030' long and 80' wide. It is capable of taking up steamers 300' long, drawing 18', and of 2,700 tons displacement. The hauling rope is 14" steel and the drum (7 ft. diameter) for winding the rope, weighs 36 tons. A vessel of 2,700 tons displacement can be hauled up in 2 hours and a small coaster in one hour. The depth at the entrance at high water is 28' 6", the length of slip above high water is 437' on rail level; above low water is 593' on rail level.

**The Nos. 2 and 3 Slipways.**—These are each 993½' long and 60' wide.

They can each take up steamers 290' long, drawing 17', of T. 2,000 displacement. Vessels can be hauled up in 1½ hours. The hauling ropes, as in the No. 1 Slipway, are of 14" steel. The cradles are operated by electric motors of 200 B. H. P. each, and so arranged by means of underground shafting that either motor can operate either slip.

The depth of these slipways at high water is 27' 6".

The length above high water is 405' on rail level and above low water 561' on rail level.

**Steel Pierheads.**—These give a fair lead to ships entering all slips.

Patent slips are recognized as affording superior facilities and favorable conditions for painting with the best preservative results, owing to the free circulation of air under and around vessels in their elevated position on the slips, and advantages of this nature have already been remarked on vessels painted on the Taikoo Slips.

**The Building Yard.**—The building yard is 550' long, 300' wide, and is fully equipped for the construction of all classes of floating craft. Ranged round the building yard are the platers shed, moulders loft, joiners and pattern makers shops and the necessary shipbuilding stores.

**The Chief Motive Power** is electricity generated by means of gas engines described later under the heading of "Power House."

**Gas Producers.**—Gas is produced from three Double Shell Mond Gas Producers made by the Power Gas Corporation of Stockton-on-Tees, capable of generating gas equal to 4,000 B. H. P. of which 3,000 is for the gas engines and 1,000 for the furnaces, etc., throughout the yard. This gas plant is situated on the Northern side of the yard adjoining the sea wall.

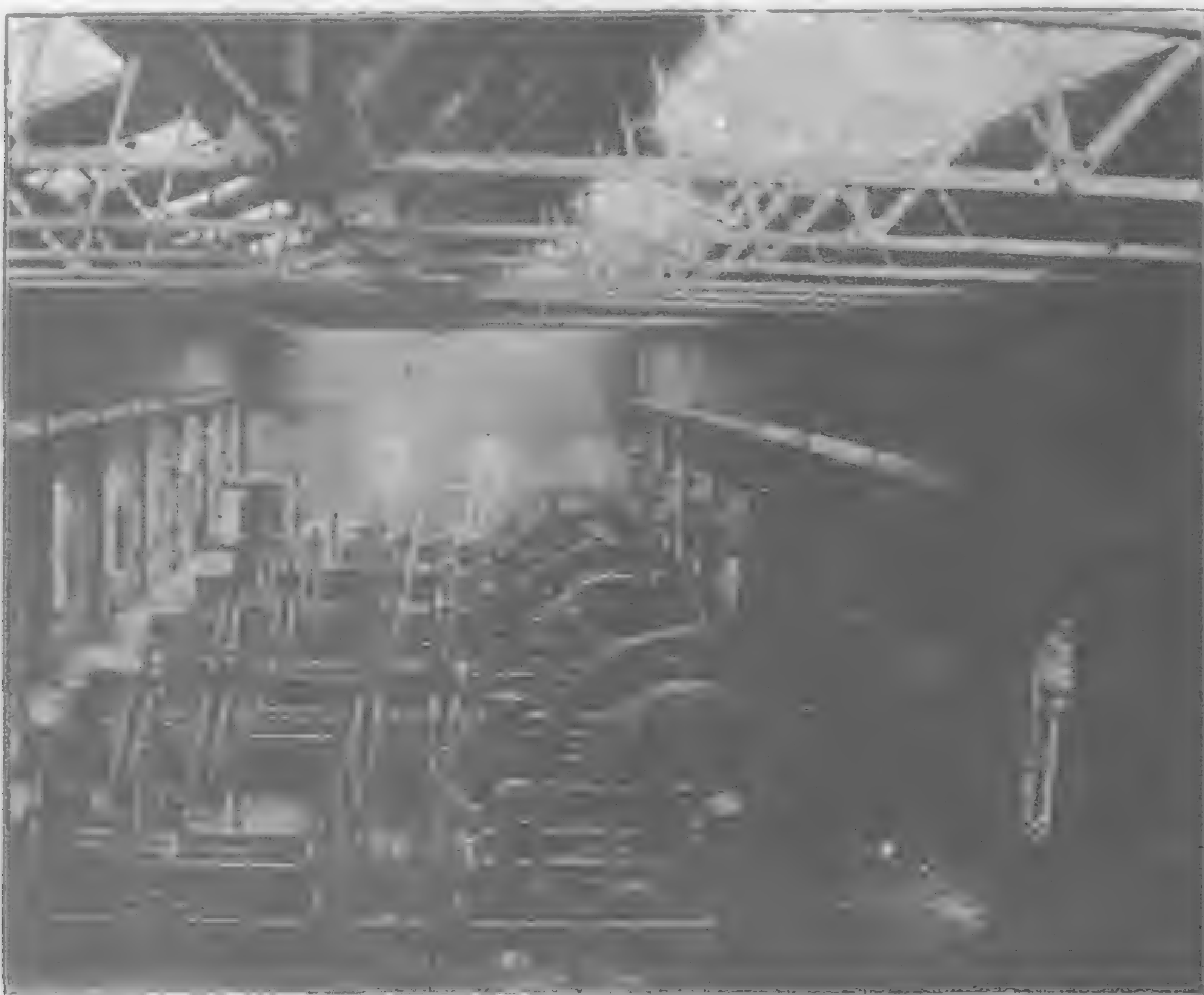
**Power House.**—The power house consists of a building 280 feet long by 57 feet wide in which are installed the following:

Two tandem double acting gas engines of the Cockerill-Westgarth type manufactured by Messrs. Richardsons, Westgarth & Co., Middlesborough, each capable of giving 550 B. H. P. coupled direct to two 375 K. W. Compound wound continuous current generators.

Two twin tandem double acting gas engines of the Cockerill-Westgarth type, each capable of giving 1,100 B. H. P. coupled direct to two 750 K. W. Compound wound continuous current generators, which transmit the power to various parts of the yard for driving machinery for all purposes.

Two sets of three throw motor driven hydraulic pumps made by Fullerton Hodgart & Co. of Paisley, for a working pressure of 1,000 lbs. per square inch coupled to an accumulator, are situated here, from which are led pipes to the different shops for flanging, heavy riveting, shell and keel plate bending, joggling machines, etc., by hydraulic power.

Two sets "Sentinel" Patent Compound motor driven air compressors by Alley & Maclellan Ltd. of Glasgow, are capable of compressing 500 cubic feet of free air per minute to 100 lbs. per square inch. From these are led pipes to the dock slipways and various shops for pneumatic riveting, caulking, chipping, drilling, etc.



INTERIOR OF POWER HOUSE





S. S. "UNION" IN TAIKOO SLIP SHOWING PROGRESS OF WORK ON SEPT. 5TH, 1910

The full length of the building is traversed by a 15-ton electrically operated crane.

*The Main Workshops.*—These comprise boiler shops, engine erecting shops, heavy and light machine shop, brass finishing shop, forge and smithy, iron and brass foundries, coppersmiths' and plumbers' shops, etc.

Other departments situated at convenient positions in the yard to the work they undertake are joiners and patternmaking shops, timber stores and saw mills.

*The Cranes.*—The electric sheers, manufactured by Messrs. Geo. Russell & Co. of Motherwell, situated on the sea wall, lift 100 tons at a 70' radius and smaller weights at a larger radius, with an increased speed.

The various workshops are fitted with electric overhead travelling cranes for dealing with weights ranging from 5 tons in the shops for light work to 100 tons in the boiler shop, and there are locomotive cranes and derricks throughout the yard.

*The Sea Wall.*—There is a depth of water of 39 feet at high water spring tides for the greater part of the length of the wall which will enable ships of any size to berth alongside for the removal of fitting of heavy boilers, machinery, etc.

In addition to the 100 ton sheers, waggon and cranes roads are installed at the quay side, so that other cranes can deal with lighter loads at points along the wall.

*The Offices.*—These are a substantial block of buildings overlooking the harbor on the one side, and the entire dock premises on the other. They are 3 storeyed fire-proof and built of brick and cement concrete floors comprising accommodation for the management and secretarial staff, counting house and drawing and time offices.

*The Dwelling Houses* for managers of departments are commodious buildings erected on hill sites commanding a complete view of the yard and sea approaches. There are blocks of foremen's houses overlooking the yard, and native houses have been erected in the vicinity capable of accommodating over 6,000 workmen.



TWIN SCREW STEAMER "SHASI." LENGTH 245' 40" BEAM, AND 10' 6" DEPTH, BUILT BY THE TAIKOO DOCKS FOR THE CHINA NAVIGATION CO., LTD., FOR PASSENGER AND CARGO TRAFFIC ON THE YANGTZE





THE CHINESE GOVERNMENT DRYDOCK AT FOOCHOW

Located at Pagoda Anchorage a mile distant from the Arsenal. Its entrance is silted up and has to be dredged to permit of docking a ship



THE FOOCHOW DRYDOCK.—DOCK ENTRANCE AND PUMP HOUSE



THE SHIPBUILDING BERTHS AT FOOCHOW ARSENAL

### THE FOOCHOW ARSENAL AND DOCKYARD

This important Imperial Naval Arsenal and Dockyard is situated at the Pagoda Anchorage in Foochow and is known locally as the Mamoi Arsenal. This institution was first built under French direction in 1875, and by a singular turn in international relations was almost destroyed by the French Fleet under Admiral Courbet in 1884 as well as all the fortifications and Fokien naval forces. Since that time the arsenal has been restored and in addition a new dock was ordered constructed in 1887 on Losing Island. This dock is over 300 feet in length and modernly equipped. It has very powerful pumps and a steel caisson making it a very important yard for the repair of Imperial vessels and for the construction of small craft. The reconstruction and direction has been carried on largely under French experts. The extension of the present establishment is now under consideration, and last year the Peking Government sent a deputation abroad to study shipbuilding and the management of naval yards in foreign countries and arranged for the purchase of a large site in addition to the present works for the construction of additional buildings for machine shops and foundry.

Of the recent vessels turned out by this dockyard was the S. S. *Ning Shao* for the Ningpo, Shaoshing S. N. Co., for the service between Shanghai and Ningpo, that made her initial trip July 19th of last year.

This vessel is 240 feet in length with a 42 foot beam and draught of 10 feet loaded. She makes 13 5 knots an hour; is equipped with twin screws, and built of steel throughout. Electric light is installed and every modern convenience provided in her appointments. This gives an idea of the growing capacity of the dock to turn out modern work and with the proposed reorganization and the expenditure of large sums of money in expansion by the Federal Government, the Arsenal and Dockyard promise to take a prominent part in the development of China's navy and merchant marine.

### THE WHAMPOA DOCK AND NAVY YARD

The Whampoa Dock and Navy Yard Naval Yard is about all that remains at Whampoa of any special interest, but its importance must not be overlooked for the reason that it is the naval headquarters for the South China Gunboat squadron where all the repairing is done. It is also the location of the Government torpedo school.





THE SHIPBUILDING BERTHS AT FOOCHOW ARSENAL

There were mud docks at Whampoa owned by Chinese long before Hongkong became a British port. They were utilized for the repair of sailing craft in the early days of the shipping trade, but foreigners were not satisfied with the facilities or the supervision of the repairs by Chinese and finally the P. & O. paved the way for foreign supervision by arranging that Mr. John Couper should supervise all the work done on the company's vessels. Later Mr. Couper leased the mud docks and added the Couper Dock which was much larger and built on more modern lines. In the clash over the Lorch Arrow Affair between the British and the Chinese, the latter destroyed the Couper Dock in part and Mr. Couper was kidnapped. In 1863 Couper's son, who secured part of the indemnity for his losses, sold his interest in the Couper Dock to Messrs. Douglas, Lapraik & Co. and the Hon. Thos. Sutherland. This transaction initiated the formation of the present Hongkong & Whampoa Dock Co. Ltd.

The mud docks which were included in this sale were resold to the Chinese Government and with some improvements since added are now known as the Whampoa Dock and Naval Yard. It is expected that the Chinese Federal authorities will provide funds for the extension and further modernizing of this station when the reorganization of the navy is under way.

#### W. S. BAILEY & CO.

This firm of engineers and shipbuilders was founded at Hongkong in 1897 by Mr. W. S. Bailey, who began business as consulting en-

gineer and importer of engineers' requisites. In 1900 Mr. Bailey was joined in partnership by Mr. E. O. Murphy, and the present works at Kowloon Bay were established.

The works occupy about six acres, and have a sea frontage of 450 feet, so that eight vessels may be laid down at the same time. When established only three years, the company received the order for the Canton River steamer Kwong Chow (now the Kwong Sai) of 600 tons displacement and 200 feet in length. The boat was completed a year later, and up to that date was the largest steel vessel built in the Colony. In 1905 the firm undertook the construction of the steel twin-screw steamer the Kwong Tung, the steel cruiser Loong Sheung (Flying Dragon) for the Imperial Chinese Navy, a steel twin-screw lighter, a steel oil barge 150 feet in length for the Standard Oil Company of New York and the steel buoys for the Manila Government. The firm erected large oil tanks at Haiphong and Saigon for the Standard Oil Company, and similar installations at Hongkong. In seven years the firm have turned out over eighty vessels, including sternwheelers, light draught vessels, and motor boats—both twin and single screws.



CHINESE IMPERIAL ARSENAL AND MINT AT FOOCHOW, ERECTED AND MANAGED BY FRENCH ENGINEERS. EQUIPPED THROUGHOUT WITH FRENCH MACHINERY. A YANTSZE RIVER STEAMER ON THE WAYS UNDER CONSTRUCTION.

## MACDONALD & CO.

One of the leading engineering firms of Hongkong is that of Messrs. Macdonald & Co., who were the first to undertake the construction of steel piers and wharves. The firm was formerly known as Kinghorn & Macdonald, but in 1903 it was established under its present style. The offices of the Company are in York Buildings, Hongkong, and the works are at Kowloon. The equipment of the works enables all classes of harbor and repair work and the construction of marine engines up to 200 horsepower to be carried out. The site occupied forms part of the land that has been reclaimed in the bay, and adjoins the Kowloon-Canton Railway station yard. It has a good water frontage of 400 feet in length, and a slipway capable of taking vessels up to 150 tons. The firm has carried out a large number of important contracts, including the building of wooden and steel lighters, steam launches, steel jetties and steel piers at Canton (one for the

Hamburg-Amerika Linie), the principal workshops at Messrs. Butterfield & Swire's new dockyards at Quarry Bay, two piers at Tai Kok Tsui for Messrs. Arnhold, Karberg & Co.,

and a pier for the Standard Oil Company at Lai-chi-kok. Under contract with the Government, the firm also built Blake Pier, Hongkong's principal landing place. They removed



STEAM LAUNCH "HARBOR NO. 1." FOR MANILA, BUILT BY MACDONALD &amp; CO.





GENERAL VIEW OF THE NEW AMOY DOCK CO.'S PROPERTY

the stone barriers in the Canton River which were put down during the first war to prevent foreign ships from entering the river, and, under contract with the Imperial Maritime Customs, constructed several lighthouses in the Canton and West Rivers. After the great typhoon of September, 1906, they were called upon to repair many of the lighters and launches that had suffered damage.

Mr. Donald Macdonald, M. I. Mech. E., M. I. M. E., the head of the firm, has had a long and valuable training in various engineering works. He is surveyor to the Bureau Veritas, British Corporation, and other registers.

Among the recent important construction by Messrs. Macdonald & Co. was the steam launch "Harbor No. 1" built for the Philippines Custom Service which suffered from an accident while proceeding under its own steam to Manila through the carelessness of the engineer. This vessel is 62 feet over all; beam, 11 feet; depth moulded, 6 feet. The boiler is 6 feet in length and 5 feet 9 in. in diameter, working pressure 150 lbs. per sq. in. It supplies steam to a set of compound surface condensing engines having diameter of cylinders 8 in. and 16 in. with 10 in. stroke. This vessel was given exhaustive and satisfactory trials in the presence of the Supervising Inspector of Machinery of the Insular Bureau of Customs and accepted before it left for Manila. The statement of A. Gillan, Master Mariner who was in charge of the launch on the voyage, is conclusive that the engineer had by his carelessness ruined the boilers and when he discovered the seriousness of his fault jumped overboard. No fault can be charged to the construction or installation.

Another important feature of this company's activity was the construction of an

oil lighter with a capacity of 120 tons of oil in bulk now employed in the local Hongkong and Canton trade. The dimensions are: Length over all, 97 feet; beam, 18 feet; depth moulded, 6 feet. The motive power is generated by a 76 b. h. p. Kromhout marine type twin cylinder kerosine engine. On this vessel's first trip to Canton fully loaded a mean speed of 7.5 knots was attained, one-half knot more than her estimated speed. A powerful three throw pump is installed for dealing with the cargo and is driven by a belt from the crank shaft of the motor.

Besides this firm's shipbuilding activity it has secured the contract for the construction of the Swatow water works and is now doing the preliminary work on this project.

#### THE NEW AMOY DOCK COMPANY, LTD.

The dock owned by the New Amoy Dock Company has been in existence since 1858, but the Company, as at present constituted, was floated in 1892, being registered in the British Colony of Hongkong with a subscribed capital of \$67,500.

Since that time nearly \$100,000 have been invested in new machinery and upon improvements to the property.

The company carries on the business of marine, mechanical, and electrical engineers, shipbuilders, boiler-makers, and iron and brass founders. They possess a well-constructed granite dry dock, capable of taking vessels up to 310 feet between perpendiculars; machine shop, foundry, boiler shed, smithy, and carpenters' shed, equipped with modern machines;



. AMOY ENGINEERING WORKS



AMOY ENGINEERING CO.'S WORKSHOP



GRANITE DOCK, OF THE NEW AMOY DOCK CO.



# THE TANJONG-PAGAR DOCK BOARD



GENERAL VIEW OF THE TANJONG-PAGAR DOCK WHARVES

This government institution succeeded in 1906 to the property of the Tanjong Pagar Dock Company of Singapore and extensive plants including harbor work and dockyard extension placed under its direction. Among the important works included having reference to Far Eastern Shipbuilding was the construction of a new dock 860 feet in length, with at entrance 100 feet, and depth, 35 feet, in addition to four large graving docks then in operation. Besides the docks the Board controls the Tanjong Pagar Wharf two miles in length and the Keppel Harbor Wharf 300 feet long. These wharves are equipped with powerful sheers and cranes with lifting capa-

and a 20-ton crane on the sea-wall for the handling of heavy substances. Among the machines are a plate-rolling machine, capable of rolling plates up to 18½ feet; a punching and shearing machine, which can take 1½ inch plates; and some up-to-date lathes, upon one of which the largest tail-shaft can easily be manipulated.

The company can undertake practically any repairs which coastwise shipping may demand. It has been fairly successful, from a financial point of view, from the start, and its future prosperity seems to be assured.

The works are superintended by Mr. Robert W. Black, an engineer possessing a wide and varied experience.

## THE AMOY ENGINEERING COMPANY, LIMITED

Chinese capital controlled and directed by a British engineer is the combination behind the Amoy Engineering Company, Ltd., of Kulangsu, Amoy.

The undertaking was registered in Hongkong, in 1893, as a limited liability company, with a capital of \$30,000. The Company builds and repairs launches, repairs steamers in harbor, and does general engineering work. Its slip for building launches, tugs, etc., is 110 feet in length, and its patent slipway 290 feet. It has also a double-power capstan, and sheers capable of raising anything up to ten tons.

The managing director and superintendent of the works is Mr. J. D. Edwards.

city] of 45 tons. Bodegas with a capacity of over 300,000 tons are provided for cargo. The equipment for salvage work is very comprehensive and a fleet of tugs, launches and lighters is engaged in the service of the Board.

The following is a description of the docks and shipbuilding yards of the Board:

*Graving Docks.*—Victoria Dock (Tanjong Pagar), opened in 1868, was built of granite. It is 450 feet long, 65 feet wide at the entrance and has 20 feet of depth in water on the sill at highest Spring tides.

*Albert Graving Dock.*—(Tanjong Pagar) was opened in 1879 and is constructed of concrete. Its length is 480 feet; width 60 feet at entrance and its depth 21 feet on the sill at highest Spring tides.

*No. 1 Graving Dock (Keppel Harbor).*—Opened in 1845 and constructed of granite; 415 feet in length; 42 feet wide at entrance; depth, 15 feet on the sill at high water tides.

*No. 2 Graving Dock (Keppel Harbor).*—Opened in 1869 and constructed of granite; 444 feet in length; 65 feet wide at entrance and 19 feet in depth on the sill at highest spring tides.

*Graving Dock (Prye, Province of Wellesley).*—This dock is 340 feet long, 50 feet wide at the entrance with a depth of 15 feet on the sill at Spring tides; also Patent Slip at Prye is capable of accommodating vessels up to 110 feet on the keel.

In addition to these docks there is now a new dock 860 feet in length. All the docks are equipped with powerful centrifugal pumps and may be emptied in from two to four hours as required. The workshops fitted with steam and hydraulic machinery of the most modern type and equipped with every description of tools required for the construction and repair of ships and machinery, adjoin the several docks.

*Machine Shops.*—The machine shops are fitted with a large variety of modern labor-saving appliances. The lathes are capable of boring cylinders 100 inches in diameter, turning pistons 9 feet in diameter, and shafting up to 45 feet in length.

Each department has suitable cranes for handling weights, with every appliance re-

quired for the efficient and expeditious construction or repair of hulls and machinery of iron, steel, or wooden vessels.

Extensive Blacksmiths' shops adjoin the machine shops, with appliances capable of making forgings for crank shafts of 12 inches in diameter, and welding shafting up to 11 inches in diameter.

The Foundries are fitted for making every description of iron, brass and bronze castings, propellers and cylinders up to 10 tons in weight.

The boilermaking shops are fitted with the latest hydraulic machinery, overhead travelling cranes, &c., capable of constructing boilers up to 50 tons.

Repairs to boilers are executed with the utmost despatch. Hydraulic jacks to lift 150 and 300 tons, suitable for raising the furnace crowns of marine boilers, are part of the equipment.

*Telephone Service.*—Every section of these gigantic works may be reached by telephone. Instruments having been installed in all the wharves, docks and offices and the system is made available to the public without charge.

*Shipbuilding Yards.*—These yards are suitable for building steel, iron, composite or wooden vessels of any size, and the Board will furnish plans, specifications, and all requisite information on application. There are a number of steam launches always in course of construction, ready for completion at short notice.

The development of this splendid system of docks, so closely identified with the history of Singapore, originated in the early enterprise of the Tanjong Pagar Dock Company. The original premises of the company were situated about a mile westward of the city, but in 1900 the company purchased the property of the New Harbor Dock Co. situated about three miles farther westward of the city. In 1904 the government decided to take over the whole of the property and in 1906 the award was made and the transfer consummated. The award amounted to about £3,000,000. Since that time the direction of the docks has been under the control of the Tanjong Pagar Dock Board.





GENERAL VIEW OF THE PORT OF SABANG, UNDER CONTROL OF THE SABANG BAY HARBOR AND COAL COMPANY

### SABANG BAY HARBOR & COAL CO.

Up to about 1893, Sabang Bay, in Sumatra, and the Island of Pulo Weh, in which the harbor is situated, was inhabited by only a small number of natives. In this year the advantage of Sabang as a base for the numerous Dutch gunboats, etc., then occupied in subduing the Achinese, became recognized, and with this in view a workshop fitted for ordinary repairs to steamers was erected, and a Government floating dock with a lifting capacity of 3,000 tons was installed, and is in use at the present time. It is only, however, within the last five or six years that the situation of Sabang as a port of trans-shipment for the rapidly-growing trade of the northern part of Sumatra, and as a coaling port for steamers proceeding through the Straits of Malacca, has been appreciated.

From the inception of its commerce, the Port of Sabang has been under the control of a private concern. The Sabang Bay Harbor and Coal Company, which, under the immediate auspices of the Netherlands Trading Society, has shown commendable energy in pushing the fortunes of its undertaking. This private company has built the entire stretch of wharves which now line a large part of the bay, from its own funds without Government subsidy.

As a coaling port, the geographical position of Sabang brings it in the track of all vessels proceeding to or returning from the Far East, either *via* the Suez Canal, or the Cape of Good Hope.

The company has installed a plant consisting of four electric transporters, each weighing 120 tons, running on rails all along the numerous coalsheds, 24 in number, and when discharging a cargo, iron buckets containing 25 hundredweight of coal are filled in the holds of the colliers, thence lifted and carried by travellers above the sheds from which points they are lowered through hatches and automatically capsized upon touching the coal heap.

In the reverse operation of bunkering, buckets are also used wherever possible, but owing to the construction of steamers it frequently happens that part, at any rate, of the coal must be placed on board with baskets. In such cases the baskets are filled in the sheds and carried on board by the travellers where they are deposited in the most suitable spot for the completion of the operation by the force of coolies employed by the company.

These transports have now been in use for more than two years, during which time they have worked to the satisfaction of the company, and also to the satisfaction of the steamship owners using the port, who have benefited by the quick despatch obtained.

The company has from the first made no charge for harbor dues, pilotage, etc., on steamers calling for bunkers, all such charges being invariably included in the prices quoted for coal. This absence of charges involves also a complete absence of many of the formalities and petty delays so irksome to captains and owners.



FLOATING DOCK AT SABANG BAY



BUNKERING PLANT AT SABANG BAY



# RILEY, HARGREAVES & CO., LTD.

The firm of Riley, Hargreaves & Co. was originally started in quite a small way as far back as 1865, and has since developed into one of the most noteworthy concerns of its kind in the Far East.

It was converted into a Limited Liability Company in 1899, with a capital of \$1,000,000.00, Straits currency. It possesses branch works and establishments in the five leading towns of the prosperous Federated Malay States, and has agencies throughout the neighboring Dutch Islands, Siam, Indo-China and the Philippines. The company is in the unique position of owning the only privately managed ship building yard in Singapore.

Its shipbuilding establishment is situated on a spit of land known as Tanjong Rhu, about three miles from Singapore town, with a frontage to the sea on the East side and facing the mouth of the Gaylang River on the West side.

On the East side there are three slips, the largest of which is capable of taking vessels up to 170 feet, there is also a wharf and steam sheerlegs with a lifting capacity of 40 tons. On this side is an extensive saw mill fitted with modern labor saving machinery, and large stocks of selected teak and other hardwoods all ready seasoned and fit for immediate use are stored.

On the West side there are 10 berths suitable for building ships in steel or wood from 30 to 300 feet long. There are also the well equipped blacksmiths', boilermakers' and fitting shops well stocked stores, and the moulding loft.

The yard is under skilled European supervision and the work turned out compares favorably with that of home establishments.

Riley, Hargreaves & Co., Ltd. are at present devoting much attention to the design and construction of motor lighters, river launches and stern wheel steamers, which are in great demand by the many rubber companies whose properties are situated in places only accessible by water.

Among vessels built and engined by the Company may be mentioned the "Seamew" (the steam yacht built for the Governor of the Straits Settlements), length 197 feet, Engines of Triple Expansion Condensing Type 15", 25" and 40" X 24", and the "Sarie Borneo" length 195 feet, Engines of Triple Expansion Condensing Type 17", 27", and 43" X 33".

In addition to its shipbuilding business the firm has separate departments and establishments in which are carried out civil, mechanical and electrical engineering.

The town stores situated in Battery Road

are replete with every class of ships' and engineering stores, and captains or owners of vessels calling at Singapore may confidently rely upon their requirements being fulfilled with promptitude and despatch.

The firm's launch meets each incoming steamer, and special attention is paid to any commands entrusted to its representative.

The electrical department have installed complete plants in several of the local steamers, and it speaks well for their knowledge of tropical conditions that not a single repair or alteration has been made since the plants were handed over, a great difference from the installations which have been sent out by home makers, as specially prepared for the tropics, and which require considerable tuning up before they are satisfactory.

The Civil Engineering Department recently carried out the construction of a Ferro Concrete Lighthouse at One Fathom Bank, Straits of Malacca, which is believed to be the only one of its kind, built in the sea, in the world. Other work in hand includes wharves for the Siamese States Railways in the territory recently ceded to Great Britain, and the laying of a large gravitation main in connection with the new water works scheme for Singapore.



STEEL LIGHTHOUSE AT FORT CANNING, OVERLOOKING THE HARBOUR OF SINGAPORE. HEIGHT FROM GROUND TO FOCAL PLANE, 58 FEET. BUILT FOR THE COLONIAL GOVERNMENT S. S.



VESSELS ON COMPANY'S SLIPWAY



FERRO CONCRETE BRIDGE AT PANDAN, NEAR SINGAPORE. BUILT FOR THE COLONIAL GOVERNMENT S. S.



FERRO CONCRETE LIGHTHOUSE AT ONE FATHOM BANK, STRAITS OF MALACCA. HEIGHT FROM H. W. L. TO FOCAL PLANE, 96 FEET. BUILT FOR THE COLONIAL GOVERNMENT, S. S.





MOTOR LAUNCH "ARTHUR," LENGTH 80 FEET, BUILT BY RILEY, HARGREAVES & CO. FOR THE ASIATIC PETROLEUM CO., LTD., SINGAPORE



COLONIAL YACHT "SEAMEW," 197 FEET LONG. BUILT FOR THE GOVERNOR OF THE STRAITS SETTLEMENTS

The engineering works at Kampong, Malacca, comprise boiler fitting and blacksmiths shops, foundry and erecting yard.

The boiler shop, the power of which is derived from a suction gas engine, has one of the most up-to-date hydraulic rivetting plants in the Far East, and in addition to manufacturing all classes of boilers, many miles of light steel tested pipe lines for use in the tin mines are turned out annually.

The fitting shops are equipped with modern

machinery, the largest lathe being capable of turning shafts up to 30 feet long.

The blacksmiths shops have a full range of forges and steam hammers and all kinds of light and heavy work is undertaken.

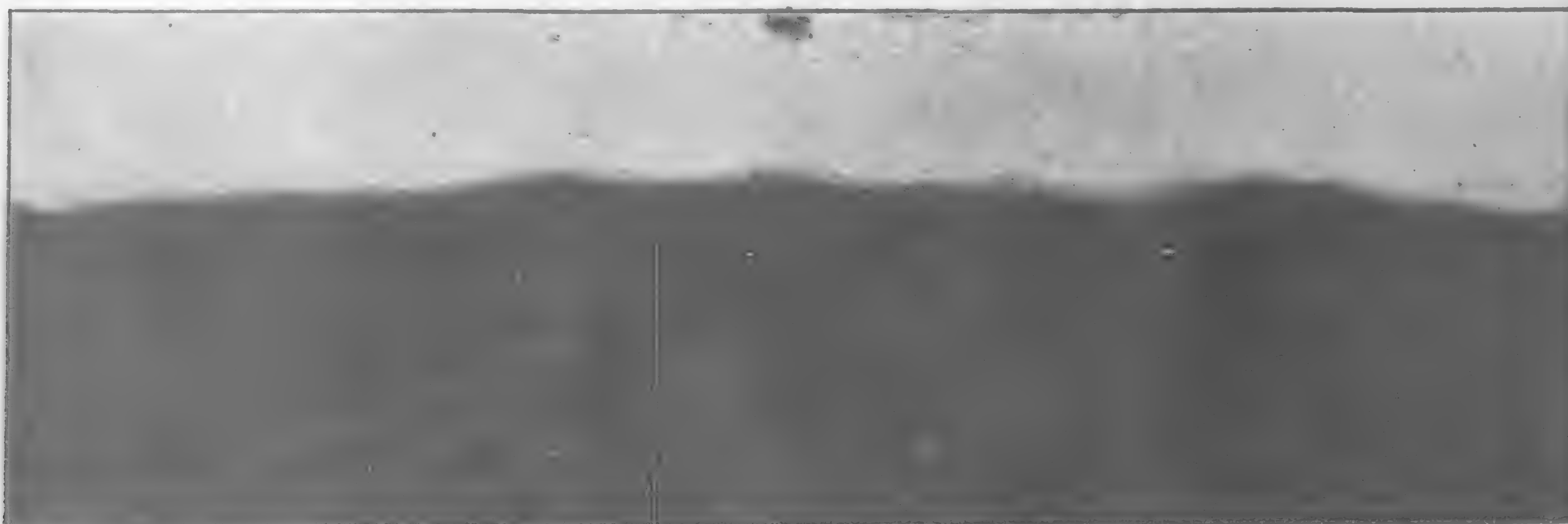
The foundry has a capacity of single castings up to 10 tons and is under efficient European supervision.

At the works, Kampong Malacca, are kept large stocks of iron and steel in all the British Standard Sections, tubes, contractors plant,

mining and railway equipments, paints, oils and sundries.

They have made a speciality of rubber machinery and accessories, and are sole Agents for the well known firm of Bertrams Ltd., Edinburgh.

Large stocks are held of suitable sections in girders, angles and tees to meet demands for the supply of Rubber Factories, Drying Stores, smoke houses, coolie lines, bungalows, etc.



ROUGH TOP ENCLOSURE BETWEEN THE NORTH BORNEO TRADING COMPANY'S MILL AND OLD WORKSHOP, SAWMILLS, SHIPBUILDING SHEDS, OFFICES, ETC., IN THE BACKGROUND





NORTH END OF ENGINEERING SHOP



BOILER-HOUSE OF THE MILLS; SHIPBUILDING SHEDS, CORNER OF WORK-SHOP IN THE DISTANCE

### THE CHINA-BORNEO COMPANY, LTD., SANDAKAN

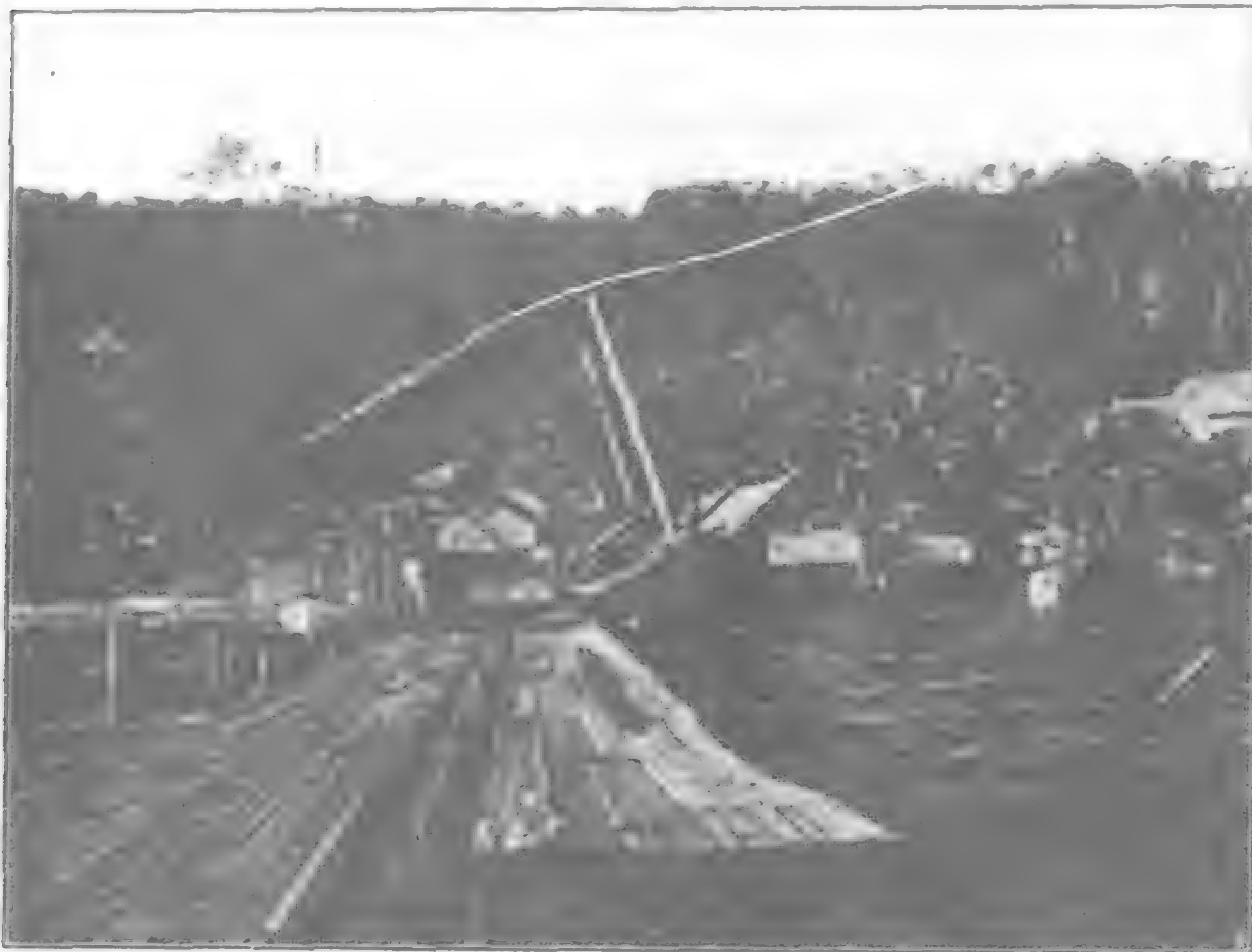
The China-Borneo Company, Ltd., was formed in 1888, but has been twice reconstructed. It has now a capital of \$720,000 and has paid good returns to shareholders for years past. In Sandakan, Borneo, the Company has two large sawmills, as well as a patent slipway for vessels up to 800 tons and engineering shops. It does all its own repairs, lays its

own jungle railways, builds launches and lighters, and does general engineering. The labor staff numbers about a thousand Malays and Javanese.

### THE NORTH BORNEO TRADING CO., LTD.

The North Borneo Trading Co., Ltd., with headquarters at Sandakan, besides controlling many departments of industry, engage in shipbuilding, general engineering and contracting.

The shipbuilding yard is capable of turning out any kind of wooden vessel up to 500 tons and has turned out large numbers of steam launches, lighters and lorchas. All the machinery is imported from Great Britain. The workshop is up-to-date and engineering work of all kinds is carried on with dispatch. A certified engineer is in charge of the entire works. The company's plant is located inside Sandakan Bay and vessels drawing 18 feet may moor alongside the company's wharf.



WHARF OF THE ENGINEERING SHOP



PREPARING TO LAUNCH A BIG LIGHTER



THE CHINA-BORNEO CO.'S PATENT SLIPWAY, SHIPBUILDING PLANT AND ENGINEERING SHOPS.—SLIPWAY TAKES VESSELS UP TO 800 TONS ANY STATE OF TIDE.—VIEW OF THE CUSTOM HOUSE AND WHARF





U. S. S. "PISCATAQUA" AND TORPEDO BOAT "DALE" ON SLIPS

## EL "VARADERO" DE MANILA



FOUR MASTED SCHOONER "ALTA" AND S. S. "MINAS DE BATAAN" UNDERGOING REPAIRS AT CAÑACAO

El Varadero de Manila is a limited liability company, established in the year 1884, being the oldest established in the Philippine Islands. The company possesses ship-yards, two marine railways and workshops situated at Cañacao, Cavite, capable of turning out vessels up to 2,400 tons gross register. The workshops consist of Machine shop, Foundry, Black-smith shop, Copper-smith shop, Boiler-shop, and Saw-mill, all fitted out with the most modern machinery. The firm is capable of undertaking ship-building, ship-repairs, tank construction work, etc., etc. The ship-yards and slip-way are situated in the Bay of Cañacao, in close proximity to the historic battle field. The gun-boats "Callao," "Arayat," "Pampanga," "Samar," "Paragua," captured from the Spaniards by the U. S. fleet, were built by the Varadero company; and the "Callao" and "Samar" are still in service on one of the rivers of China.

The "Varadero" has proven its ability to handle its share of the government work, within its limitations, and the following war vessels have been successfully docked and repaired since the American occupation of the Islands: The United States ships "Wilmington," "Helena," "Petrel," "Castine," "Marietta," "Princeton," "Vicksburg," "Annapolis," and the captured gunboats "Isla de Cuba," "Isla de Luzon," "Don Juan de Austria," "Villalobos," "Elcano," "Quiros," "Pampanga," "Paragua," "Samar," "Callao" and "Arayat," also the large seagoing tug-boats "Piscataqua" and "Wampatuck." The transport "Pompey," "General Alava" and "Manila" have also been docked and repaired.

The gunboats "Pampanga," "Paragua," "Samar," "Callao" and "Arayat" were built for the Spanish Government during the years 1887 and 1888 at Cañacao, and the excellence of the work is attested to by the fact that the boats are still in service.

Besides the above mentioned gunboats, numerous small merchant vessels for the inter-island coasting trade, and lighters and cargo boats have been successfully built and engined from these shops. One of the gunboats, the "Bulusan," constructed for the Spanish Government was destroyed and sunk by the insurgents. The company also built 12 steel and iron coal barges for the United States navy, shortly after the occupation, to the complete satisfaction of this exacting branch of our service.

The officers of the company are: General Manager, Rafael Reyes; Acting General Manager, Alfonso Rocha; Works Manager, Alexander Young Superintending Engineer, Chas. H. W. Aitken.



U. S. GEODETIC SURVEY STEAMER "FATHOMER" AND COAL HULK ON SLIPWAYS

### MARINE BOILER WATER TREATMENT

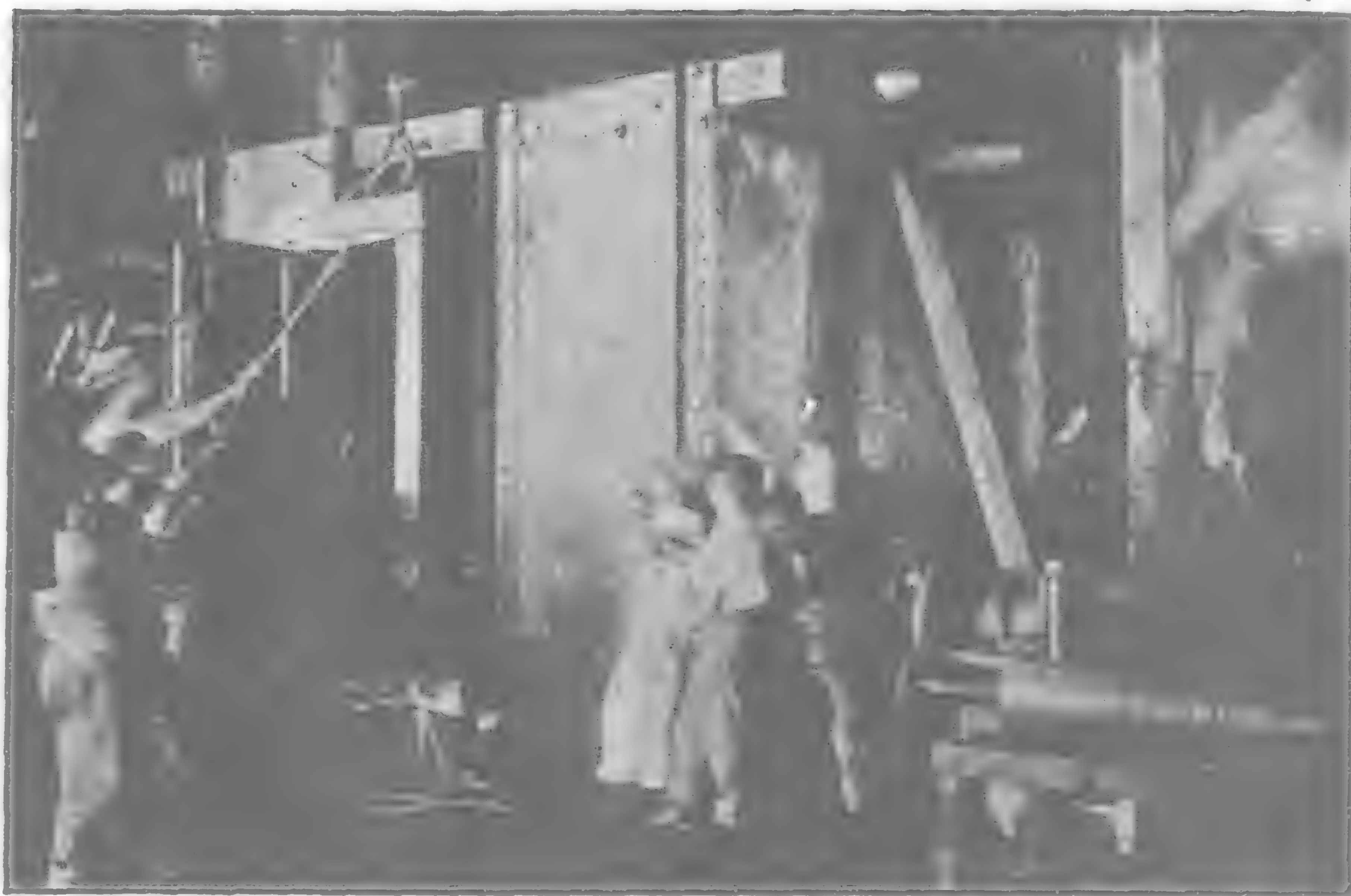
The invasion of Far Eastern territory by the Dearborn Drug and Chemical Works of Chicago in 1910 with their modern methods of treatment of feed water for all classes of boilers by intelligent application of the principles of chemistry instead of by the old "cure-all" preparations, together with their lubricants scientifically produced to give the best possible results, has been marked by the general appreciation of the shipping trade, manufacturers and other interests suffering from the serious depreciation of boilers from the action of salts and gases developed from the waters utilized. These works have established



branches at Tokyo, Tientsin, Shanghai and Hongkong and recently installed their oriental headquarters and branch laboratory in Manila. In all these sections the Dearborn Drug and Chemical Works have met with the usual success that has attended their operations throughout the United States and territories. Mr. E. C. Brown, a graduate of the University of Illinois where he took a course in Chemistry, is in personal charge of the Far Eastern interests of the firm and Mr. F. O. Smolt, a chemical engineer, is now in charge of the Oriental Headquarters and Branch Laboratory in Manila.

In all their operations the Dearborn Drug and Chemical Works include twenty-four active branches and they are naturally expansionists. The work of manager Brown in less than a year in the Orient has been most successful and with the establishment of the Oriental Headquarters in Manila, he is taking the initiative in making that American port his distributing center for the East. The program includes an invasion of the Straits and Federated Malay States extending the Dearborn circle of branches until no part of the globe is neglected.

Having special reference to Marine Boiler Water Treatment which is of the greatest interest to the extensive shipping interests



SAN NICOLAS IRON WORKS: STEEL, SAFE DEPOSIT VAULT MADE FOR MORO PROVINCE



MACHINE SHOP OF THE SAN NICOLAS IRON WORKS

of the Orient it may be noted that the Dearborn Drug and Chemical Works have given special attention to the treatment of waters used as supplies for marine boilers so as to prevent scale or incrustation and when it is remembered that a treatment satisfactory when applied to feed waters of one character would serve no good purpose if prescribed for another, the adaptation of treatment arrived at by careful chemical tests must appeal to those who have suffered from the "cure-all" faker who prescribes the one kind of treatment for all the different water defects.

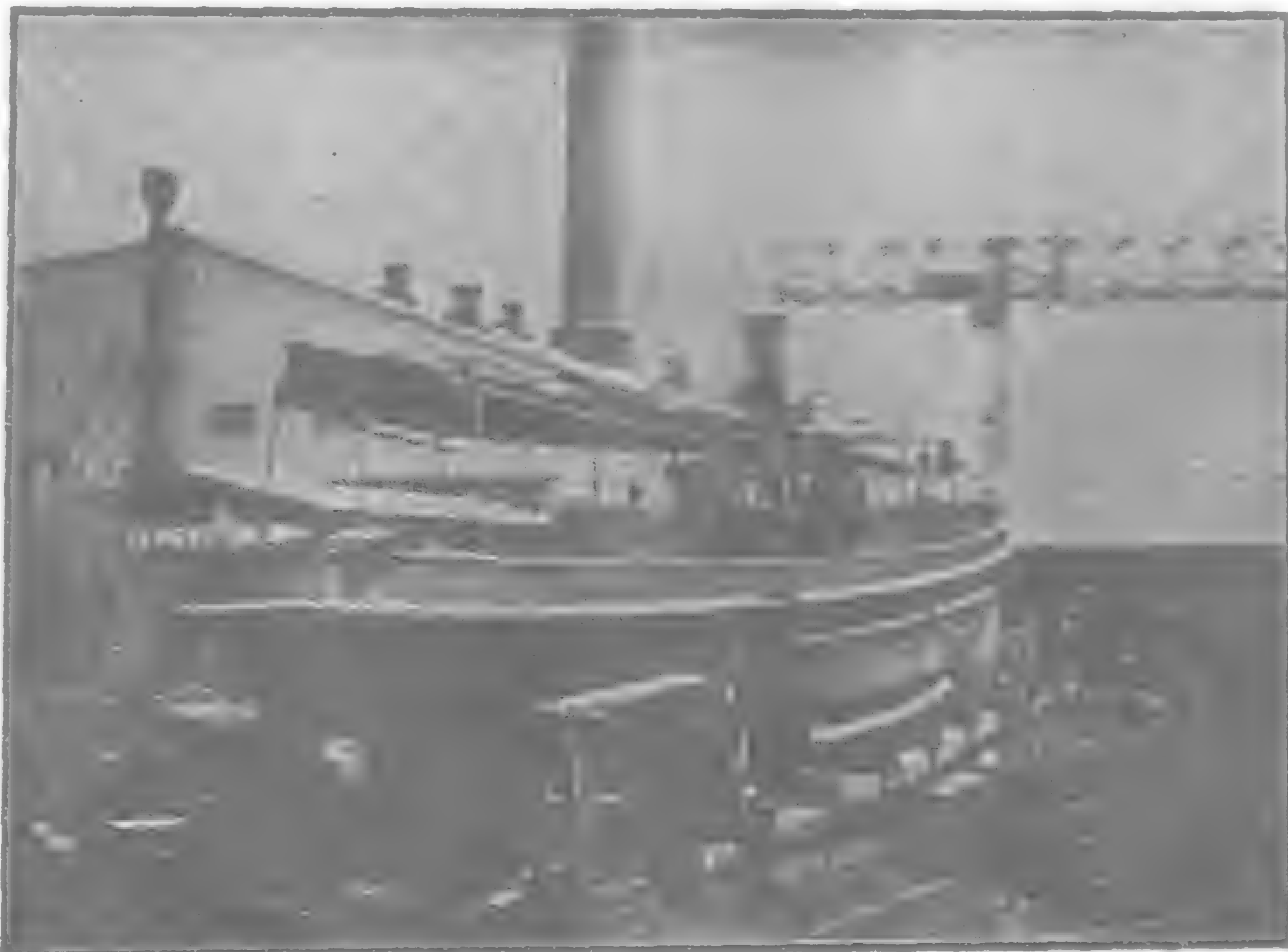
The Works have a central laboratory in Chicago in connection with their manufacturing department and the former is to the latter what the prescription druggist is to the physician. In the laboratory samples of water are analyzed in order to combat successfully the evils of scale, deposit, priming, foaming, pitting, grooving, corrosion, etc. The Branch Laboratory in Manila will serve the same purpose for the Orient as the Chicago Laboratory for the United States. Mr. F. O. Smolt who is in charge is a chemical engineer, and thoroughly conversant with the company's methods and products. A large stock of lubricants is also kept in stock.

#### THE SAN NICOLAS IRON WORKS, LTD.

This company was organized in 1900 with a capital of P300,000 and established an up-to-date plant in San Nicolas district, Manila. Messrs. Smith Bell & Company are the General Managers and the enterprise has met with marked success from the beginning. The company has a large engineering repair patronage and its machine shops and foundry are capable of handling all classes of construction. In the shipbuilding department only small vessels are built and repaired, but as this class of vessels predominate in local shipping the slipway is rarely empty.

The foundry and machine shops are equipped with all the most modern facilities for expeditious handling of orders. Recently a two-ton casting was turned up on the lathes in these works for the Philippine Government, a most difficult undertaking for a plant of this capacity, but which was promptly and satisfactorily completed, reflecting great credit on the management.

Many of the lighters used by the U. S. Army and Navy in the islands were constructed by the San Nicolas Works and several deposit vaults for the insular government constituted another feature of their activity. Mr. A. C. Sutton, the present manager, has been in charge for the last three years and his direction has been marked by ever increasing expansion of the facilities of the works to keep pace with the increased industrial activity in the archipelago.



SLIPWAY OF THE SAN NICOLAS IRON WORKS





MOTOR BOAT IN THE SERVICE OF SORSOGON PROVINCE CONSTRUCTED BY MESSRS. R. H. COOPER & CO. AND EQUIPPED WITH MEITZ & WEISS ENGINE



MARINE SLIPWAY

#### MANUEL EARNSHAW & COMPANY, LTD.

The above company was incorporated for P1,600,000 in 1909 and succeeded to the prosperous business of Messrs. Manuel Earnshaw & Co., one of the oldest engineering firms in the Philippines. The offices of this company are located at 15 Calle Barcelona, Binondo, Manila. The company controls an extensive engineering works in Manila on Calle Barcelona besides a large iron and brass foundry at 151 Calle Reina Regente, and a slipway at Cavite. Its operations include the construction and repairs to vessels and launches, boilers and all branches of mechanical and marine engineering.

The Earnshaw firm was established by Daniel Earnshaw who came to the islands in 1864 at the request of the Spanish Government to build a marine slipway in Cavite. After this work was completed he established himself in Manila in the engineering business and foundry work. The firm took charge of much of the work for the American Government and the navy during the early days of occupation and has steadily expanded. The officers of the company are: President, Mr. Manuel Earnshaw; First Vice-President, Tomas Earnshaw; Second Vice-President and Treasurer, Mr. Daniel Earnshaw, Jr.

#### H. R. COOPER & CO., MANILA

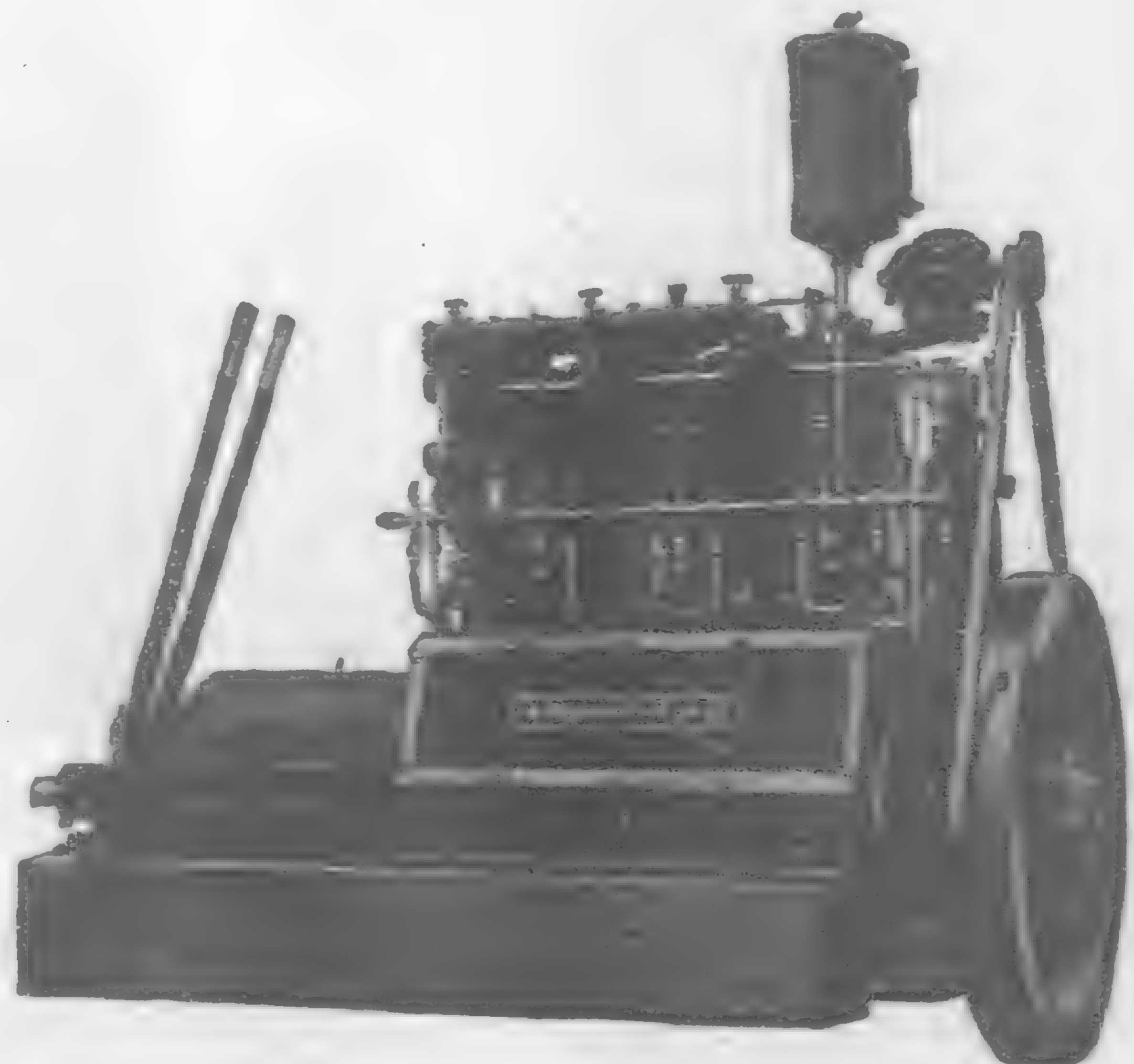
This company may be said to be among the pioneers of the modern motor boat industry in the Philippines. It has the exclusive agency for the Meitz & Weiss kerosene motor engine in the islands and perhaps no company has installed a greater number of motors in local craft than Messrs. Cooper & Co. Accompanying this sketch is the reproduction of a photograph of a launch built for a provincial government and typical of a large number constructed in Manila to the order of the company and equipped with Meitz & Weiss motors of various capacities.

The company makes a specialty of high grade construction. Only the best grades of Philippine hardwoods are used in building the frames and all the work under its direction conforms to standard specifications. The frames are copper-fastened throughout; the sheathing and deck planking is of teak and Muntz metal sheathing is utilized.

The launches are built, completely fitted, and delivered ready for sea with the exception only of fuel. The labor employed is Chinese and Filipinos. The carpentry work is done by the former and the machinery installation by native mechanics.

#### MESSRS. CASTLE BROS. WOLF & SONS, MANILA

Fairbanks-Morse & Co., through their Agents in Manila, Messrs. Castle Bros.-Wolf & Sons, have done quite a fair amount of



FAIRBANKS-MORSE MARINE ENGINE



# THE MANILA TRADING & SUPPLY CO.

Since American occupation of the Philippines there has been an increased call for better methods of transportation than that offered by primitive sail boats and bancas propelled by paddle or pole. The call first

found for small internal combustion engines at moderate price.

The Manila Trading & Supply Co. was one of the first concerns to recognize the large field for motor boats, and commenced



FIGURE I.—THE MANILA TRADING & SUPPLY CO.

came from Government officials who, in their inspection trips to out of the way places, found need for better and faster boats. The Government therefore placed many motor boats in service, and the advantages offered by such boats soon appealed to the natives. Today the natives in the Philippines are looking for better means of transportation, with the result that an increasing demand has been

business, more particularly in their stationary and vertical kerosene engines and gasoline and kerosene motors for launches—indeed, of these latter they have shipped from 3 H. P. to 100 H. P.

In addition their windmills under the mark "Eclipse" are well known throughout the Islands.

It is some four years since they first introduced their Duplex Steam pumps for tanks and boiler feed and their success has been more than satisfactory.

Owing to the difference in price between kerosene and gasoline the motors and engines operated by the former are much more in demand and the low consumption combined with the steady work of the Fairbanks-Morse Motors, whether under full power or less, strongly recommends them to the operator.

## NEW RUSSIAN REVENUE CUTTERS

Five new motor boats are under construction by the Russian Government for revenue service on the Amur River. The power equipment is to be Fairbanks-Morse three cylinder heavy duty Marine Engines developing 30 horsepower on kerosene.

It is interesting to note that the order for these engines resulted from the sale of a 15 horsepower Fairbanks-Morse Marine Engine to the Russian Government some time ago, and which gave such reliable service that the new boats were ordered to be equipped with the same make of engine.

The manufacturers have just issued a beautiful new catalog describing all types of Marine Engines, which will be sent free to all of our readers who will write to Fairbanks & Morse Co., Chicago, Ill., U. S. A.

a campaign of demonstration. The importance of having a reliable engine, which, while not the cheapest, was at least within the reach of the Filipinos, was realized and the agency for the *Ferro Engine* was secured for the Philippines and Southern China. For speed work and for large boats, the agency for the *Sterling Engine* was secured.

The result of their campaign may be seen

Manila Trading & Supply Co., the boat shown in Fig. I is one of the best. This boat was built by the Hongkong and Whampoa Dock Co., and is now owned by the Customs Service, being used for night patrol work in Manila Bay. The boat is about 35 feet long and is equipped with a 25 40 H. P. Sterling Engine for speed work, an electric arc search light and dynamo, and an electric horn. The system of mufflers used makes the boat practically noiseless. The boat made on its trial trip 16½ miles per hour.

The Bureau of Customs has also had in use for about three years three converted ship's boats equipped with Ferro Engines. One of these boats has recently been dismantled and the engine, after about three years use, installed in a hull in place of a steam engine and boiler, propelling the boat better than before.

One of the prettiest and fastest boats in the Islands is a speed boat on the S. S. "Aguilar". That boat is 25 feet long and is equipped with an 18-25 H. P. Sterling engine. It makes about 18½ miles per hour. It was built at the Cavite Navy Yard. A similar boat for use on the S. S. "Rizal" is now being built at the Bureau of Navigation.

An unusual type of boat is one in use by the Bureau of Internal Revenue on the Cagayan River. That Boat has triple screws, having 7½ H. P. Ferro Engines on the two sides and a 15 H. P. Ferro engine in the center. The boat is about 40 feet long, has a cabin, and is lighted throughout with electricity. The boat was built at the Taikoo Docks. The electric lighting system is of the Dayton launch type, by which a dynamo charges storage batteries when the engines are running, thus permitting the use of the electric lights at any time, whether the dynamo is running or not.

Figure II represents a type of shallow draft boat supplied by The Manila Trading & Supply Co., such as is used on the shallower Philippine rivers. The boat is equipped with a 15 H. P. Ferro engine. There are several boats of this type in use in the Philippines.

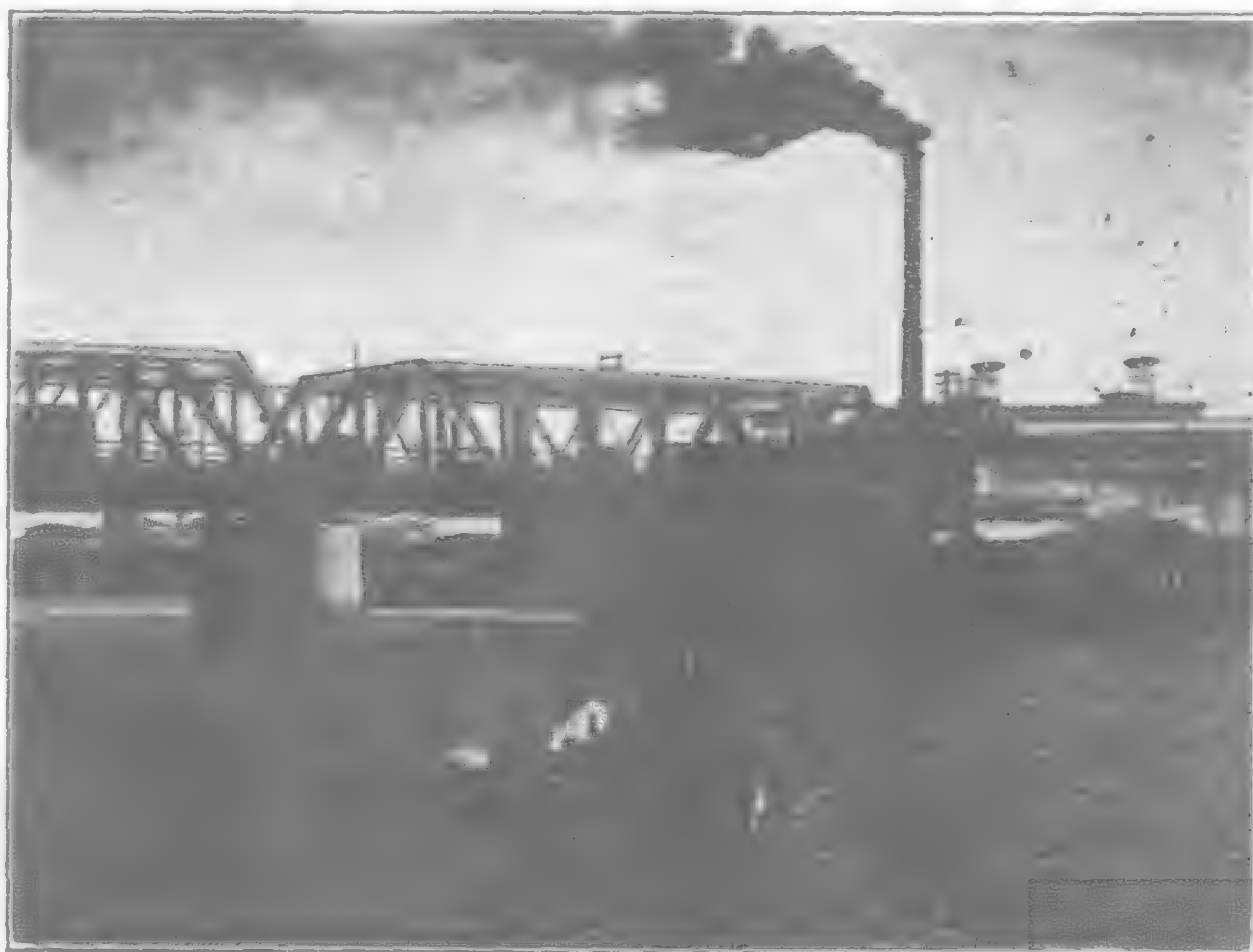


FIGURE II.—THE MANILA TRADING & SUPPLY CO.

in all parts of the Islands. Shallow draft boats have been built and equipped with *Ferro Engines* for use on the rivers. Many *Ferro Engines* have been installed in bancas and other small native built boats.

Of the special motor boats sold by The

At the present time many native bancas are being equipped with Ferro engines of small power, as such engines have been found to meet the needs of the natives in fishing boats and for transporting passengers and cargo on shallow rivers.



## GOVERNMENT DOCKS AND ENGINEERING WORKS, MANILA

Among the most important works in the Philippines are those established on Engineer Island at the mouth of Pasig River and operated by the Bureau of Navigation. Under control of this Bureau are three slipways, two located on the South of Engineer Island served by marine railways with a capacity for receiving vessels of 1,000 tons and 200 tons respectively, while located on the North side of the Pasig is a drydock capable of receiving vessels up to 150 tons.

The slipways served by the marine railways are utilized for the repair of the vessels of the Bureau of Navigation fleet as well as outside work. The 1000-ton dock being used for the larger vessels and the 200-ton for the repair and construction of the smaller craft including river, bay, and sea going launches, cutters, ketches, etc. As the fleet of the Bureau comprises over 46 vessels besides numerous small craft, these slipways are very active.

The dry dock on the North side of the Pasig is utilized by the Division of Port Works for keeping its dredges, launches, etc., in repair and there is now being constructed a 100-ton snag boat which, when completed, will be utilized for removing snags from the Cagayan River. Its equipment will include dredging machinery, derricks, and other machinery for removing the obstructions. The cost is estimated at 75,000 pesos.

Besides these slipways a special division has been established for the construction of motor boats for government service. There is now being constructed a thirty-foot motor launch with six-foot beam for the Governor General as part of the equipment of the s. s. Rizal of the Navigation fleet. A 24 h. p. Sterling engine will provide the motor power and the vessel is designed to make 20 knots drawing 12 inches.

A large number of motor boats have been built on the Island for the different departments of the Government, ranging from ten to eighteen knots. Invariably the engines installed are the Ferro, Sterling, Meitz & Weiss, the Gray and the Remington.

In connection with the shipbuilding and repair plants are large and modernly equipped machine shops and sawmill in which all the necessary machine and wood work covering the construction and repair of vessels is turned out with expedition. Besides the marine work the Light House Division operated by the Bureau of Navigation in conjunction with the shops on the Island provide the most modern facilities for the construction of lighthouse equipment.

The shops are equipped to cast all the propellers for the cutters up to 8.5 feet in diameter from tip to tip with 12 foot pitch. In the steel construction section all the steel towers for the lighthouse service are made. Among the machinery installations is a trip hammer of 100 tons capacity while the moulding and reviting and other machines are of the most modern pattern.

During the year 1910 the receipts for repair of Government vessels, etc., together with such outside work, amounted to P579,005. The Docks and shops employ a force of 300 men and the investment in plant alone is approximately P750,000.

The site of these works is ideal being situated on the New Harbor with a Pasig River frontage. As the demand for larger works increases there is every reason to believe that more extensive docks will be constructed. There have been several proposals from private capital to purchase the plant site and plant from the Government with a view to installing a modern shipbuilding plant sufficiently large to accommodate large foreign vessels calling at the port, but so far no definite action has been taken. As the works stand they are a valuable asset to the Government and very necessary for the purpose of keeping the insular fleet in repair.

The officials of the Bureau of Navigation in charge of the works are: Director, Frank P. Helm; Assistant Director, Julius S. Reiss; Second Assistant Director, L. A. Barlow; Chief Director of Port Works, K. S. Heck; Master Mechanic, Captain R. H. Robson; Inspector of Machinery, C. G. Helvering.

## U. S. FLOATING DOCK DEWEY

This dock, which is in commission at the U. S. Naval Station at Olongapo, has a capacity to receive vessels up to 18,000 tons displacement. It has a length over all of 500 feet and the same over the blocks with a width at the entrance of 100 feet and a depth of 35 feet. The construction of this floating dock for the use of the Asiatic Squadron of the U. S. Navy was authorized by Congress in 1902 and the contract secured by the Maryland Steel Company of Sparrow's Point, Maryland, in 1903. It was completed in October 1905, and turned over to the Navy Department, by whom it was then towed to Manila making the voyage of 13,000 miles in less than five months from Maryland to Olongapo where it has been in commission ever since with the exception of four months during the year 1910 when it was mysteriously submerged and was with difficulty refloated.

The first test made before taking over was the docking of the cruiser Colorado with a

land, in 1903. It was completed in October 1905, and turned over to the Navy Department, by whom it was then towed to Manila making the voyage of 13,000 miles in less than five months from Maryland to Olongapo where it has been in commission ever since with the exception of four months during the year 1910 when it was mysteriously submerged and was with difficulty refloated.

The first test made before taking over was the docking of the cruiser Colorado with a

PHILIPPINE GOVERNMENT DOCKYARDS AND ENGINEERING WORKS ON ENGINEER ISLAND, MANILA



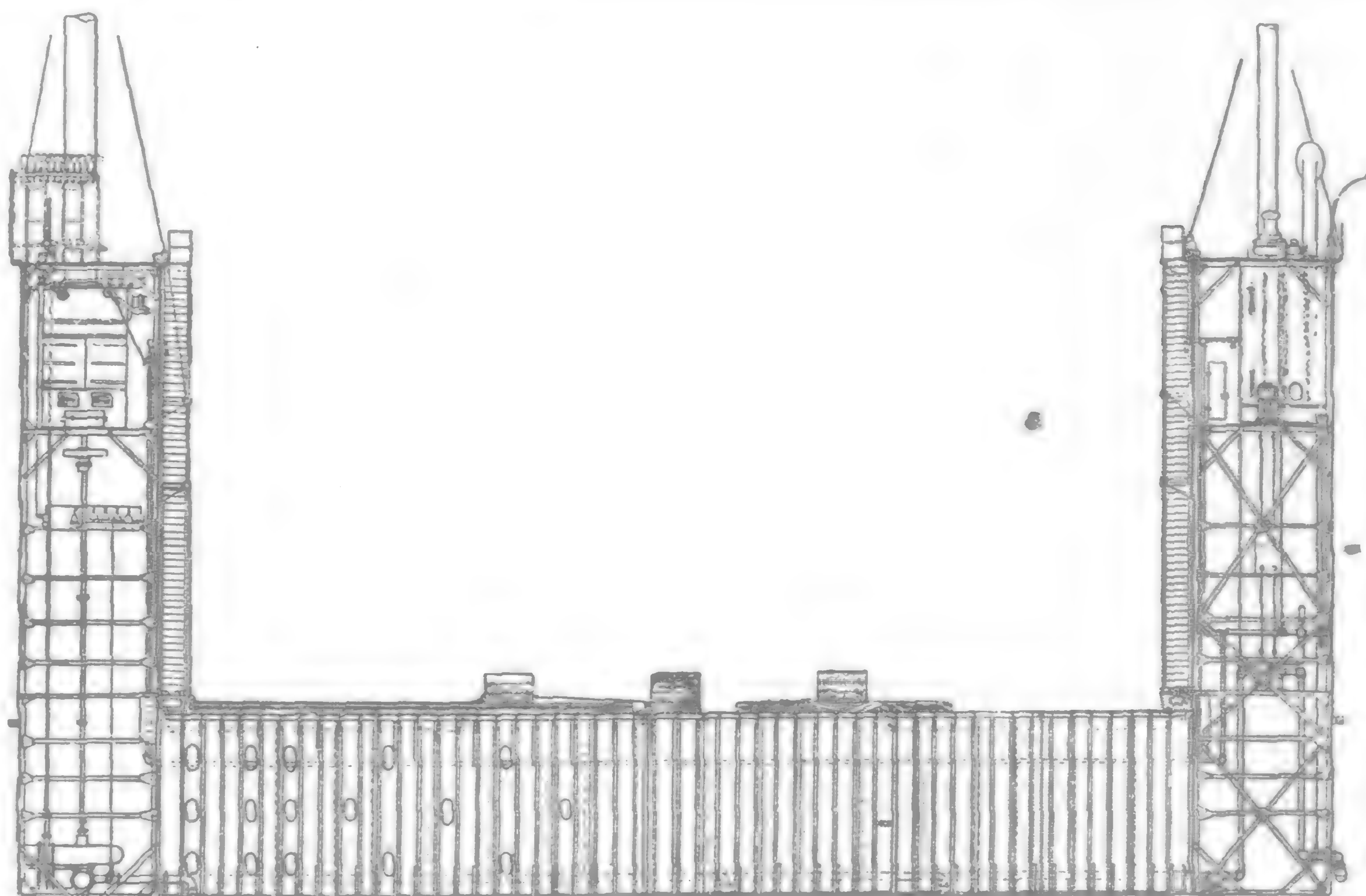
END VIEW OF DOCK, WITH BATTLESHIP ON THE BLOCKS





displacement of 13,300 tons distributed over a length of 500 feet. In this test the ship was lifted clear of the water in two hours, sixteen minutes. The second test was with the battleship Iowa, with a displacement of 11,600 tons distributed over a length of 350 feet. The vessel was lifted clear of the water in one hour and thirty seven minutes. Since the dock has been used at Olongapo, vessels have been docked and cleaned in six days and less.

The steam plant comprises three Babcock & Wilson boilers of the marine type, each having a grate area of 46 sq. ft. with a heating radius surface of 1,750 sq. ft. The steam is used for the main purpose of pumping the equipment for which comprises three 24-inch centrifugal and two 12-inch pumps of the same type. The former are used for the regular purpose for which the dock is designed while the latter are located in the end pontoons and are only used for self docking. The larger pumps are operated by a horizontal compound engine with 14.5 and 25 in. cylinders and 14 in. stroke. The cranks are at an angle of 135 degrees. With a steam pressure of 140 lbs. these engines develop at a speed of 225 r. p. m. about 225 indicated h. p. The smaller pumps are driven by simple engines with 12-inch cylinder and 10-inch stroke directly connected with the pump shaft. All the auxiliary machinery is operated by steam from a Babcock and Wilson Boiler with a grate surface of 18 sq. ft. and a heating surface of 750 sq. ft. and consists in the main of a 7-k. w. Sturtevant 110-volt generator driven by a simple direct connected engine 6-in. by

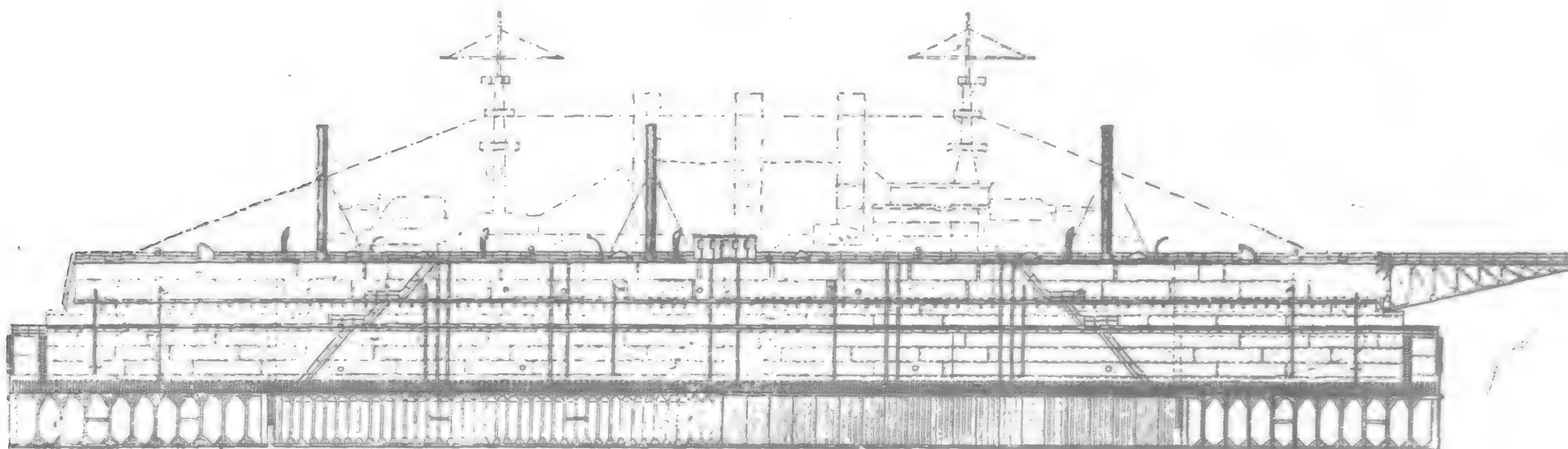


CROSS SECTION OF CENTRAL SECTION OF DOCK

6 in. and a distilling apparatus with a daily capacity of 2,500 gallons.

The cost of the dock under the original contract was \$1,124,000 gold. The steel used in its

construction weighed 11,000 tons which is held in place by 2,000,000 rivets. The total displacement is represented 30,000 tons at a draft of 16.5 feet. At light draft the dock draws 6.5 feet.



INBOARD PROFILE OF FLOATING DOCK DEWEY, WITH A BATTLESHIP ON THE BLOCKS

### THE REMINGTON KEROSENE MARINE ENGINE.

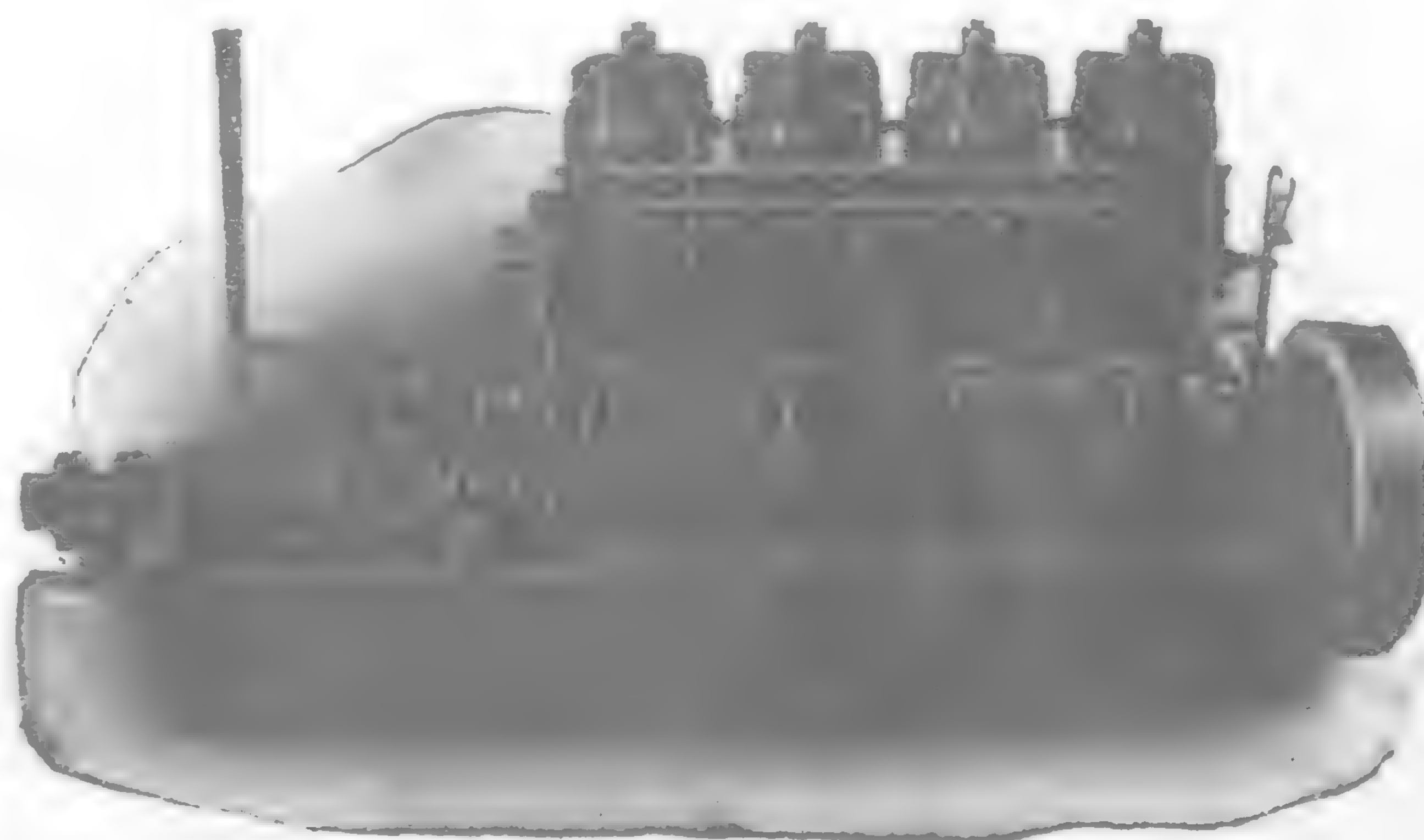
Among the kerosene motors that have been successfully introduced in the Philippine Islands the Remington marine kerosene motor holds a prominent place. The Manila agents are F. W. Thompson and Frank L. Strong and during the year a large number of Remington marine engines have been installed besides meeting the demand for manufacturing plants throughout the islands. Among the marine installations which have proven most satisfactory is one 24 h. p. Remington installed in a 36 foot launch used for towing and bay work by the Manila Navigation Company of Manila. This vessel makes 9 knots.

A 22 h. p. Remington was installed in a 35 foot boat used for passenger and cargo service on the Cagayan River, Luzon. This vessel averages 9 knots. Another 26 foot launch equipped with a 10 h. p. Remington has been ordered for the same service.

A 10 h. p. Remington has been installed on a 28 foot dispatch boat used by the U. S. Navy for dispatch service between Carabao Island and Cavite. This boat has a speed of 8 knots.

A 22 h. p. Remington marine engine is now in service in Parang, Mindanao; a 6 h. p. in Davao and 20 h. p. in Tacloban, besides a number of orders booked during the month. This engine has given general satisfaction and has a splendid future before it in the

Far East as its first introduction was early last year. Messrs. Thompson & Strong are two of the leading engineering firms of Manila whose operations extend to every section of the Philippine archipelago. They are splendidly equipped to cater to insular trade.



FOUR CYLINDER REMINGTON MARINE ENGINE



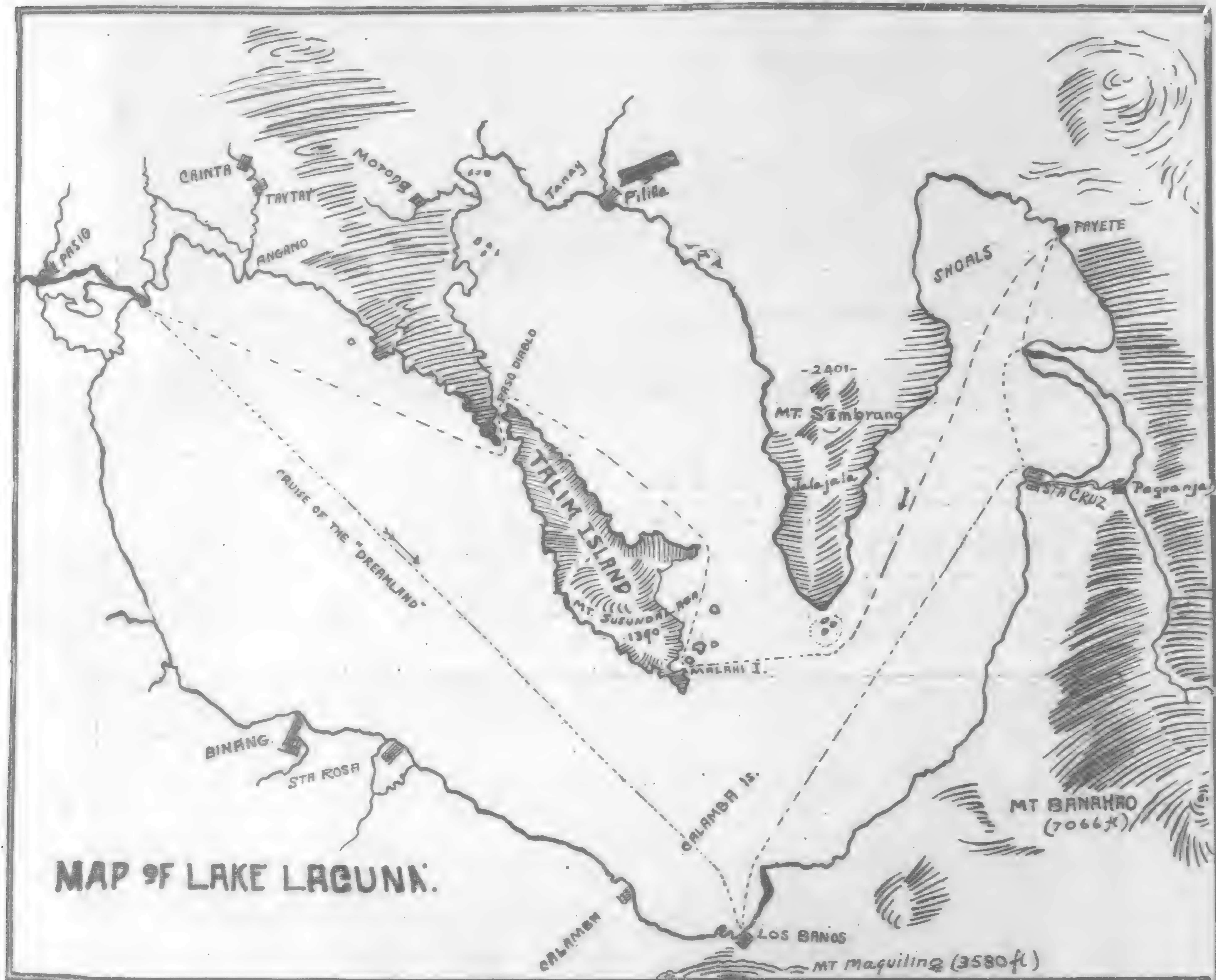
# THE MOTOR BOAT IN THE PHILIPPINES

Ten years ago there were no gasoline or petroleum motor craft anywhere in Philippine waters. Today there are hundreds. From the Northern waters of Luzon to far away Davao Gulf the internal combustion engine is now

much for the simplicity of the modern type of engine and also demonstrates the mechanical genius of average Filipino.

Of the two types of engines made the two-cycle has by far the greater lead here in

making about fifteen knots per hour and over. At Cavite the Navy has a speedy launch, also Sterling 45 h. p., that will do perhaps a knot better. Mr. C. A. Robertson of the Supreme Court Staff has a sharp-nosed speed boat, 16



MAP OF LAKE LAGUNA.

MAP OF LAGUNA DE BAY WITH ROUTE OF THE MOTOR BOAT "DREAMLAND" ON CRUISE OF 150 MILES IN THE PICTURESQUE VOLCANIC REGION OF LUZON

almost as well known to the native as is the larger steam-propelled vessel. In fact, in many places the gasoline or petroleum craft is the only power boat the natives have ever seen. Thus far the provinces are far ahead of Manila in the use of motor boats, and the demand for good and serviceable launches of from 18 to 26 feet is rapidly increasing. This is especially so for plantation work, where they are used not only for pleasure but for real service, such as towing products of the plantation to market and returning with supplies. It is astonishing, too, how quickly the average provincial Filipino achieves a complete understanding of the internal combustion engine. The writer knows of many instances where an engine has been shipped to a provincial customer, and the engine installation made by Filipinos who never before had seen a machine of this type, and only gained a knowledge of its working by careful study of the little book of instruction that accompanied the machine. It speaks

the islands. Each type has its friends, and each is represented here in Manila. It is not the writer's intention to touch on the merits of any one of these engines, suffice to say that with ordinary intelligent handling any well-known make of internal combustion engine will give satisfaction.

All sorts of nondescript craft have been converted into power boats, and in some instances these have proven a disappointment to their owners. They were either too heavy for the horsepower installed or of such clumsy model that any horsepower that might have been placed in them would have proved a disappointment. Where a prospective motor boat owner has gone to the trouble to carefully select plans and build his boat accordingly, the result has been satisfactory. There has been but little attempt, except here in Manila, to build high speed boats, the general idea being to have a moderate priced boat with a fair speed. The Customs Service boasts its Flier, Sterling 45 h. p.,

h. p. 4 cy. Brooks, that makes better than fifteen knots, and the Hon. Benito Legarda has a 26-foot Mulli that will give it a close race. To Mr. Daniel Earnshaw, of Earnshaw & Co., goes the honor of owning the speediest power-craft afloat in Manila waters. It is a 20-footer of the Viper model and was built at the Earnshaw yards at Cavite. She has a three-cylinder Gray racing type, 18 horsepower engine, and makes about 20 knots an hour.

Members of the Manila Motor Boat Club cannot boast of anything in the nature of a high-type of racing craft, and it is doubtful if the time will come when they, as a club, will care to introduce this expensive class of boats. There is so much more pleasure in the small cruising type, or the runabout, and so little expense for upkeep, that it will be hard for the racing enthusiast to break in. This club has a membership of about thirty, and is constantly increasing. Some very good boats are owned by the various



members, and as a club it has done much to stimulate the interest in motor boating in the islands. There are few week-ends that cannot account for cruising parties to the lake, or to some nearby provincial river emptying into Manila Bay. The most favored waters, however, are the Pasig with its numerous inlets from the lake, and Lake Laguna itself, that beautiful inland sea with its rugged

bridge, where the river sweeps deep and swift along the stone wall that protects the bank on the Pasig City side, we caught a fleeting glimpse of a belated city-bound street car, probably the last in for the night. After its lights disappeared behind the wooded heights above the towering bridge, we felt that we had really left Manila behind us.

"We had taken our blankets and pillows

placid waters, the dome of the sky shone resplendent with blinking stars, and like a great set piece, the Southern Cross hung low over the sleeping, mist-shrouded mountains of Laguna. Off to the west towards the low-lying shore above Taguigue, hundreds of lights flashed like restless glow-bugs and now-and-then the weird notes of the conch horn came wavering across the water.



W. A. ROBERTSON'S SPEED MOTOR BOAT ENGINED BY A 16 H. P. BROOKS. SPEED 15 KNOTS, BUILT BY THE ISLAND BOAT WORKS, MANILA

mountain shores and its enchanted islands, a two-hour run from Manila.

The delight of cruising on these inland mountain-walled waters, is best told, perhaps, by one of a party of eight who recently made a seventeen hour cruise on the Dreamland, a handsome 40 foot cruiser, 2 cy. 12 h. p. Gray motor, owned by a member of the Manila Motor Boat Club:

"We left Manila at midnight and were soon away from the glare of electric lights and out in the cool atmosphere of the lowlands above Pasig, where the river winds like a great serpent until it opens out into the lake where it has its source. Just above the Pasig

to the upper deck of the cruiser's cabin, and stretched out flat on our backs enjoyed to the full the cooling breeze and passed the time with stories and song.

"To fully appreciate the night beauties of this enchanted body of water, one must actually make the trip across the lake on a night like this. There was not even the faintest intimation of a swell on the bosom of the lake, although the afternoon before a steady sou'wester had fanned it into a sea of white-headed billows. To the left the sharp crest of Talim Island showed faintly against the fainter mists of far-away Banaho on the southern shore. Above it all, and reflected in the

It was the lake fishing fleet in rendezvous with the night's catch. The low, steady purr of our engine in the after cabin below, and the soft swish of the waves as the sharp nose of the Dreamland cut its way through the water, was new music to most of us. It seemed unbelievable that so small an engine could propel so large a craft with such ease. The first stage of our journey was reached, when the anchor was let go a few yards off the Los Baños wharf at 4:40 a. m. Maquilin's lofty peak back of Los Baños was flooded with the rays of the morning sun when we awoke, although old



YARD OF THE ISLAND BOAT WORKS, MANILA



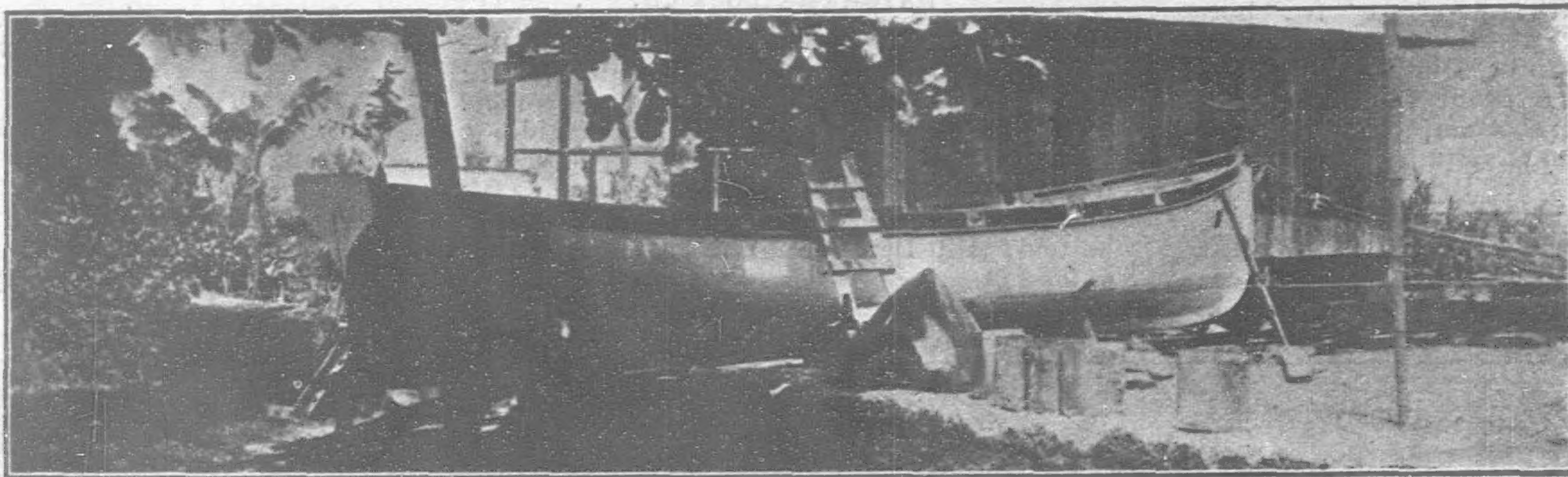
Sol himself was hidden from our view by the lofty range to the east.

"On shore at the McElvain house we partook of a most appetizing breakfast, and some of the party wished to remain afterward and try out the famous hot mineral baths. But the cool morning breeze blowing down the channel Santa Cruz was too inviting to resist longer our eastward cruise and we were soon aboard and away. With each mile of our voyage the picture of lake and mountain took on new

a night. Each shower, each day of drought, will so change the nature of its hundreds of slender falls that it never appears the same. The mighty roar of the main stream, however, is always there, singing in grand chorus where the cascade is high and tortuous, and with just the gentlest refrain where the stream glides smoothly beneath the darkened overhanging walls below.

"Three hours after leaving the cruiser we were again on board and headed for the low

of which Malahi, the old military prison isle, is the largest, looked inviting across the channel to the East as we motored on down Talim's coast towards Paso Diablo. Arriving at the latter place the anchor was again thrown out, and although a heavy current was setting through the pass, caused by a high running sea on the Western arm of the lake, the passengers were soon overboard enjoying a swim.



TOW LAUNCH CONSTRUCTED BY THE ISLAND BOAT WORKS FOR THE INSULAR LUMBER CO.

loveliness as the rising sun drove back the mists and dissolved the last lingering gloom of the mountain gorges.

"We took turns studying through the glasses each distant isle or mountain peak as we motored up the south shore towards Santa Cruz and the day was still young when we finally dropped our anchor off that port. Here we again took banca for shore and, securing carretelas, made the drive to Pagsanjan. Luzon can boast of few roads like that three-mile stretch between the two Laguna towns. Of well-rolled macadam and rounded so that it is given perfect drain, it winds with picturesque curves beneath the stately coco palms that line its entire length. And the town itself: what a pretty village! There are the usual nipa homes, but somehow they seem cleaner and better kept than in the average provincial town. There are a number of substantially built residences along well-laid-out streets and the stores in the business district would do credit to a much larger place. Located as she is, on the very foot-stool of Banahao, Laguna's highest mountain, there is excellent drainage and the most latent possibilities for civic artistic arrangement of parks and thoroughfares. Less than a mile above the town, out of dark-green and rugged vine-clad walls, the Pagsanjan river, born at a dizzy height back in the tropical jungle forest, comes tumbling down the cleft in the mountain's side; gleaming, silvery cascades, and then winds its shining miles peacefully beneath the overhanging trees, to mingle finally with the waters of the lake beyond.

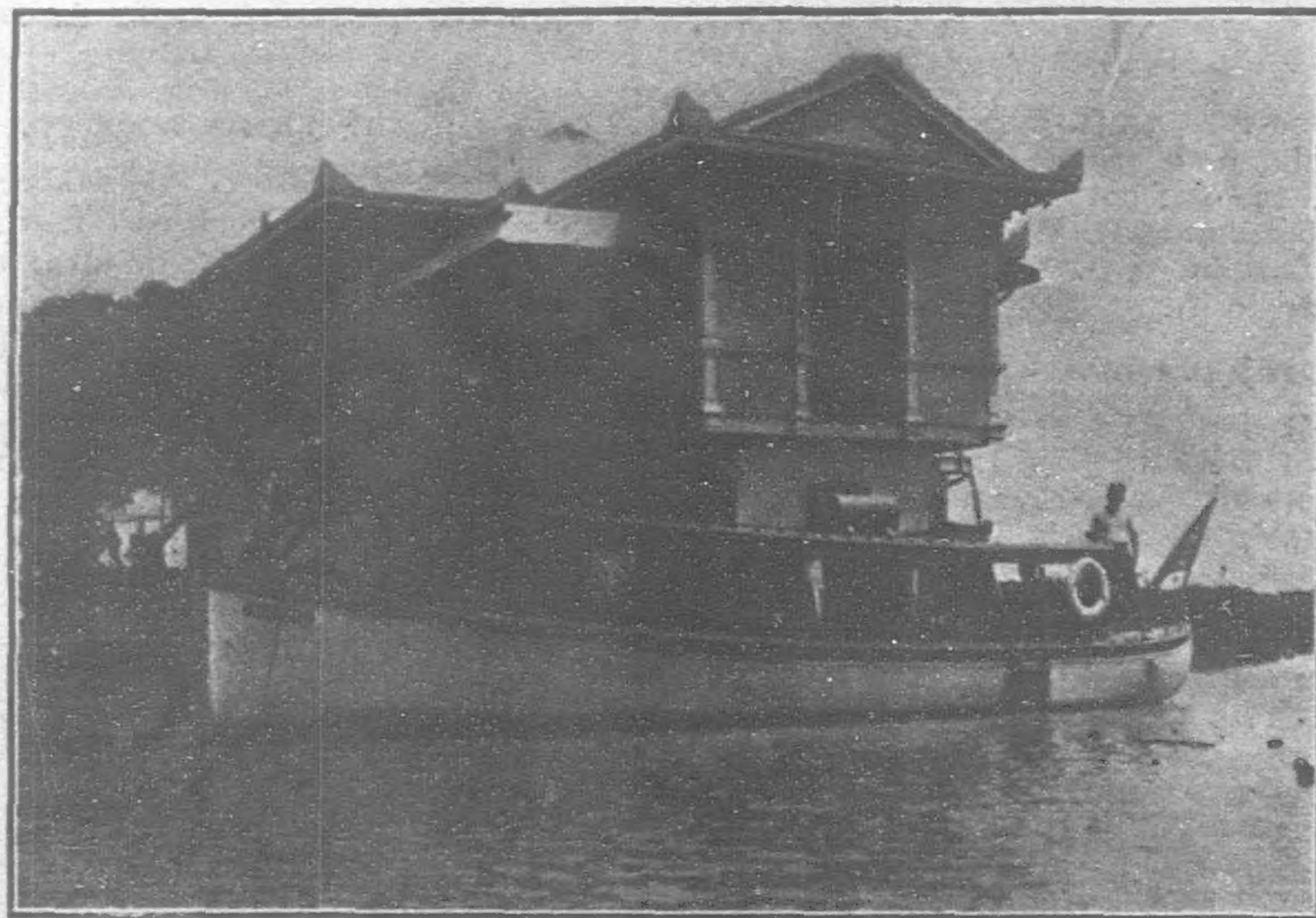
"There is no use to dwell at length on the excitement of that banca trip up the canyon for most Manilians have tried it. It was not my first trip for I had been there several times before, but like each other visit I had made, it was different. The canyon with its leaping falls will change its whole aspect in

mountain range to the east where Payete, that romantic little village of wood-carvers, nestles snugly up against the side of the flower-bedecked cliffs.

"Stepping ashore at Payete a single hour spent at this delightful mountain town only whetted our appetites for more, but with a

"The sun was still more than an hour above the western horizon when the Dreamland headed out of the pasos and into the white foam-flecked lake.

"It was a joyous trip across the 12 miles of tumbling waters to the mouth of the Pasig which we entered just as the sun dropped behind the hills bordering the Western shore



THE "DREAMLAND" AT ANCHOR OFF ISLAND BOAT WORKS, MANILA

long cruise yet before us, we reluctantly withdrew to the cruiser. Headed down the lake again, this time steering a course for Talim and the Malahi islands, we experienced a head wind that delayed all attempts at preparing tiffin. Under the lee of Talim, however, the lake was smooth, and anchorage good.

"The little cluster of green topped islands,

of the lake. There was not a person on board who did not regret leaving that wonderful panorama of lake and mist-shrouded mountains, for, although our cruise had extended over a course of more than one hundred and fifty miles, we had not visited one half of the interesting places to be found along the shores of this Enchating Inland-Sea."



# OTHER DOCKYARDS IN THE FAR EAST

## JAPAN

### BINGO DOCK YARD CO. LTD.

Location, Sansho (Mitsunoh, Island of Innoshima). Stone Dock No. 1.—Length: top, 410 ft.; bottom, 395 ft. Width: top, 82 ft.; bottom, 60 ft. Width at Entrance: top, 57 ft.; bottom, 52 ft. Depth: High tide, 24 ft.; low tide, 13 ft.

Dry Dock No. 2 (at Mitsunoh).—Length: top, 292'3"; bottom, 282'3". Breadth at Entrance: 41'9"; Depth: 15'5".

### FUJIUCHI FUKUJIRO

Location—Niihama. Wood & Stone Dock No. 1.—Length: top, 120 ft.; bottom, 105 ft. Width: top, 41 ft.; bottom, 26 ft. Width at Entrance: top, 35 ft.; bottom, 35 ft. Depth: High tide, 4 ft.; low tide, 0 ft. Wood & Stone Dock No. 2.—Length: top, 100 ft.; bottom, 90 ft. Width: top, 30 ft.; bottom, 20 ft. Width at Entrance: top, 35 ft.; bottom, 35 ft. Depth: High tide, 3 ft.; low tide, 0 ft. Stone Dock No. 3.—Length: top, 102 ft.; bottom, 90 ft. Width: top, 41 ft.; bottom, 26 ft. Width at Entrance:

29'; No. 2 dock: Width, entrance 38'; No. 1 dock: Depth on Sills, 12'; No. 2 dock: Depth on Sills, 10'.

### HARADA SHIPBUILDING & ENGINEERING WORKS

(Harada Juijiro)

Location—Osaka, Japan. Description of Docks: Wood, No. 1 dock: Length on bottom, 210'; No. 2 dock: length on bottom, 152'; No. 1 dock: width, entrance, 36'; No. 2 dock: width, entrance, 29'; No. 1 dock: depth on sills, 12' 6".

### HATOHAMA DOCK CO.

Location—Hatoama.—Stone Dock No. 1.—Length: top, 126 ft.; bottom, 120 ft. Width: top, 50 ft.; bottom, 41 ft. Width at Entrance: top, 33 ft.; bottom, 31 ft. Depth: High tide, 5 ft.; low tide, 0 ft. Stone Dock No. 2.—Length: top, 156 ft.; bottom, 150 ft. Width: top, 52 ft.; bottom, 41 ft. Width at Entrance: top, 35 ft.; bottom, 32 ft. Depth: High tide, 5 ft.; low tide, 0 ft.

### KOMPIRA DOCK CO.

Location, Shirakata. Rock cut open Dock.—Length: top, 179 ft.; bottom, 169 ft. Width: top, 41 ft.; bottom, 35 ft. Width at Entrance: top, 28 ft.; bottom, 28 ft. Depth: High tide, 10 ft.; low tide, 0 ft.

### KINUURA SHIPYARD

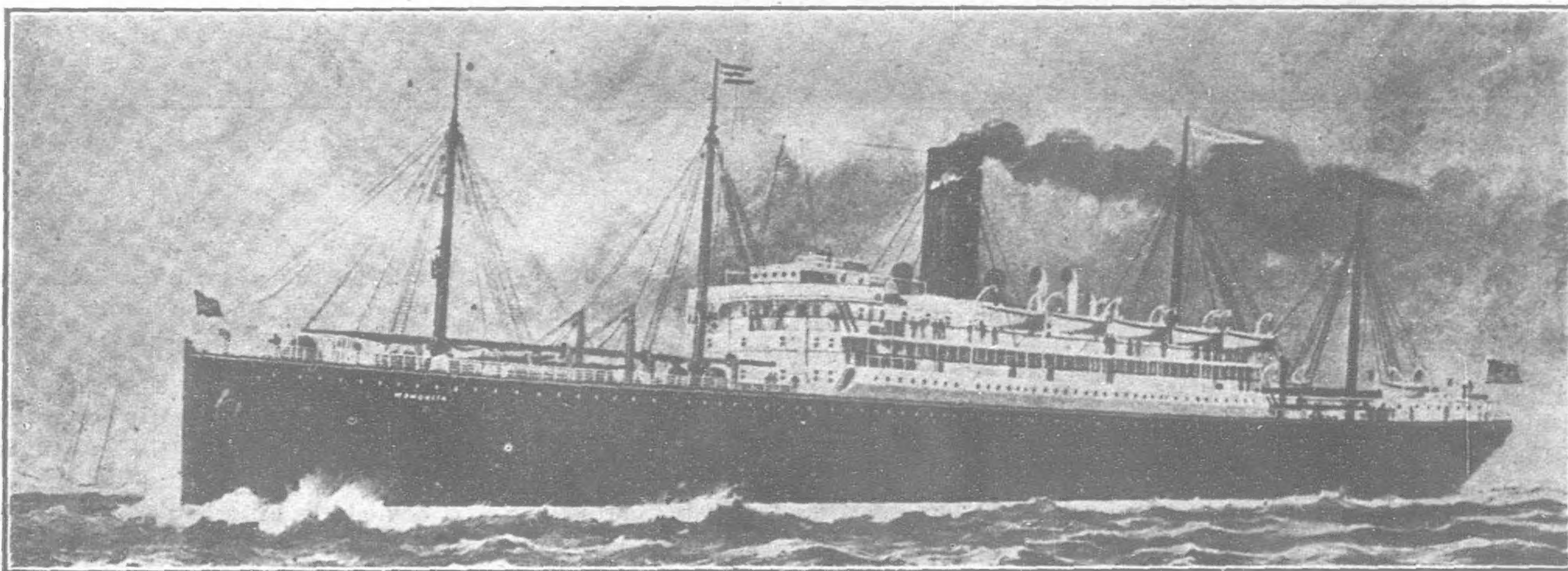
Location, Ohama, Japan. Wood Dock.—Length: top, 250 ft.; bottom, 210 ft. Width: top, 65 ft.; bottom, 32 ft. Width at Entrance: top, 41 ft.; bottom, 30 ft. Depth: High tide, 12 ft.; low tide, 7 ft.

### IMPERIAL JAPANESE GOVERNMENT NAVAL DOCKS

Kure: Dry Dock, No. 1.—Length: top, 464'0"; bottom, 413'2". Breadth at Entrance: top, 79'5"; bottom, 58'5". Depth: 28'2" on blocks.

Kure: Dry Dock, No. 2.—Length: 485'6" on blocks. Breadth at Entrance: top, 93'3"; bottom 81'3". Depth: 35'9" on blocks.

Maidzuru Naval Dockyard (Prov. Tango)



S. S. MONGOLIA 27,000 TONS DISPLACEMENT BUILT BY THE NEW YORK SHIPBUILDING CO

top; 31 ft.; bottom, 31 ft. Depth: High tide, 4 ft.; low tide, 0 ft. Stone Dock No. 4.—Length: top, 130 ft.; bottom, 115 ft. Width: top, 41 ft.; bottom, 26 ft. Width at Entrance: top, 31 ft.; bottom, 31 ft. Depth: High tide, 4 ft.; low tide, 0 ft.

### FUJIEDA SHIPYARD

Location—Osaka (Fujinagata Dry Docks).—Description of Docks: Wood; No. 1 dock: Length on bottom, 250'; No. 2 dock: Length on bottom, 156'; No. 1 dock: Width, entrance

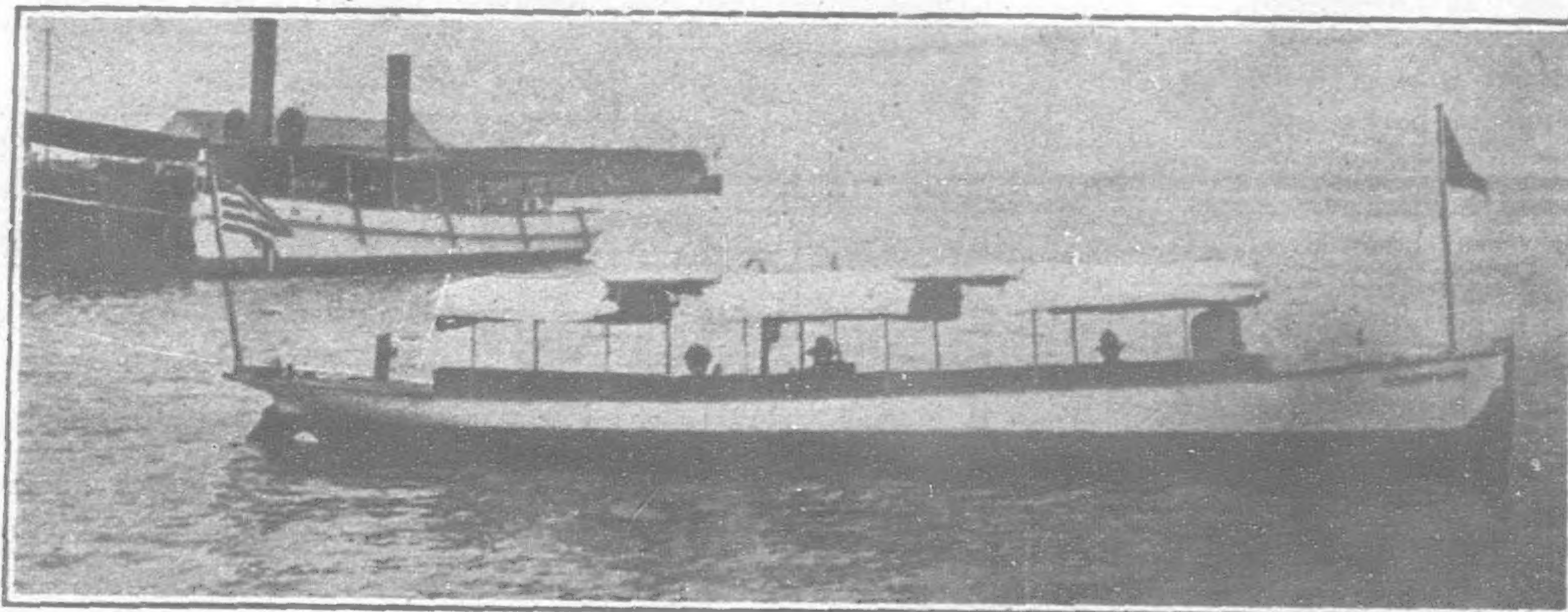
### INNOSHIMA DOCK CO.

Location, Tsuchibu (at Habu, Island of Innoshima)—Stone Dock No. 1.—Length: top, 300 ft.; bottom, 300 ft. Width: top, 51 ft.; bottom, 40 ft. Width at Entrance: top, 39 ft.; bottom, 36 ft. Depth: High tide, 13 ft.; low tide, 12 ft. Rock cut open Dock No. 2.—Length: top, 364 ft.; bottom, 357 ft. Width: top, 71 ft.; bottom, 49 ft. Width at Entrance: top, 49 ft.; bottom, 44 ft. Depth: High tide, 20 ft.; low tide, 11 ft.

Three Dry Docks: Imperial Japanese Government.

### NOCHI DOCK CO.

Location, Nochi. Stone Dock No. 1.—Length: top, 202 ft.; bottom, 196 ft. Width: top, 51 ft.; bottom, 37 ft. Width at Entrance: top, 33 ft.; bottom, 29 ft. Depth: High tide, 13 ft.; low tide, 10 ft. Stone Dock No. 2.—Length: top, 149 ft.; bottom, 146 ft. Width: top, 51 ft.; bottom, 37 ft. Width at Entrance: top, 32 ft.; bottom, 29 ft. Depth: High tide, 10 ft.; low tide, 7 ft.



PETROLEUM MOTOR LAUNCH, "FAIRBANKS MORSE" ENGINES, 10 H. P., SPEED 8 KNOTS PER HOUR. SUPPLIED BY MESSRS. CASTLE BROS. WOLF & SONS. LENGTH 38 FT., BEAM 7 FT. DRAWS 2½ FT. OF WATER. BUILT OF PHILIPPINE HARDWOODS WITH TEAK FITTINGS AT SAN NICOLAS IRON WORKS, MANILA



## MATSUO IRON WORKS AND DOCKYARD

Nagasaki (Nagahama) New Graving Dock.—Length: top, 320'0"; bottom, 310'0".  
Breadth at Entrance: top, 48'0"; bottom, 40'0". Depth: 17'0"

## OSAKA SENKYO KABUSHIKI KAISHA (OSAKA DOCK CO. LTD.)

Location: Osaka, Japan.—Description of Docks: Wood and stone. No. 1 dock: Length on bottom 254'. No. 2 dock: Length on bottom 196'. No. 1 dock: Width entrance 45'. No. 2 dock: Width entrance 45'. No. 1 dock: Depth on sill, H. W. 14'. No. 2 dock: Depth on sill, H. W. 12'

## ONO SHIPYARD

Location, Osaka, Japan.—Wood Dock.—Length: top, 180 ft.; bottom, 175 ft. Width: top, 41 ft.; bottom, 29 ft. Width at Entrance: top, 28 ft.; bottom, 27 ft. Depth: High tide, 12 ft.; low tide, 10 ft.

## IMPERIAL JAPANESE GOVERNMENT PONTOON

Ominato (Awomori Gulf).

## ONOMICHI DRY DOCK

Onomichi (Mukaijima), Onomochi Zosensho. Length: top, 212'0"; bottom, 210'0". Breadth at Entrance: top, 32'0"; bottom 28'0". Depth: 13'0".

## MATSUBA DRY DOCK AND IRON WORKS

Onomichi (Mukaijima). Length: top, 163'0"; bottom 162'6". Breadth at Entrance: 27'8". Depth: 9'0".

## OKAWA SHIPPING CO.

Location, Okawa. Wood & Stone Dock. Length: top, 250 ft.; bottom, 230 ft. Width: top, 43 ft.; bottom, 35 ft. Width at Entrance: top, 40 ft.; bottom, 30 ft. Depth: High tide, 11 ft.; low tide, 0 ft.

## AJIKAWA DRY DOCK, AJIKAWA ZOSENSHO

Osaka. Length: top, 122'0"; bottom 118'0". Breadth at Entrance: 30'0". Depth: 6'0".

## SHIMODA DOCK CO.

Location, Shimoda. Stone Dock. Length: top, 147 ft.; bottom, 140 ft. Width: top, 43 ft.; bottom, 31 ft. Width at Entrance: top, 35 ft.; bottom, 30 ft. Depth: High tide, 12 ft.; low tide, 7 ft.

## IMPERIAL JAPANESE GOVERNMENT NAVAL DOCKS

Sasebo: Floating Dock. Length: 280'0"; Breadth at Entrance: 38'0"; Depth: 11'6".

Sasebo: Dry Dock. Imperial Japanese Government: Length: 435'0"

Sasebo: Dry Dock. Imperial Japanese Government: Length: 377'0"

Sasebo: Dry Dock. Imperial Japanese Government: Length: 538'0"

Takeshiki (Tsushima) Pontoon. Imperial Japanese Government.

## TOBA IRON WORKS AND DOCKYARD

Location, Toba, Owari Bay, Prov. Shima. Stone Dock. Length: top, 283 ft.; bottom, 279 ft. Width: top, 62 ft.; bottom, 49 ft. Width at Entrance: top, 42 ft.; bottom, 34 ft. Depth: High tide, 13 ft.; low tide, 11 ft.

## ISHIKAWAJIMA S. B. &amp; K. CO. LTD.

Tokio: Ishikawajima (Dry Dock). Length:

top 299'0"; bottom 270'0"; Breadth at Entrance: top, 41'9"; bottom, 32'9". Depth: 12'0".

## URAGA DOCK CO. LTD.

Uraga (15 miles from Yokohama) Dry Dock No. 1.—Length: top, 497'0"; bottom, 482'2". Breadth at Entrance: top, 70'0"; bottom, 60'0". Depth: 25'5" on blocks.

Uraga (15 miles from Yokohama) Dry Dock No. 2.—Length: top, 456'10"; bottom, 448'4". Breadth at Entrance: top, 65'6"; bottom, 53'6". Depth: 24'4".

## IMPERIAL JAPANESE GOVERNMENT NAVAL DOCKS

Yokohama, Yokosuka, No. 1.—Length: top, 357'7"; bottom, 297'11". Breadth at Entrance: 82'0". Depth: 21'4".

Yokosuka No. 2.—Length: top, 452'9"; bottom, 447'1". Breadth at Entrance: 94'5". Depth: 28'11".

Yokosuka No. 3.—Length: top, 282'2"; bottom, 261'2". Breadth at Entrance: 45'3". Depth: 17'11".

Yokosuka No. 4.—Length: top, 541'4"; bottom, 538'8". Breadth at Entrance: 98'5". Depth: 31'11".

## CHINA

Amoy: New Amoy Dock Co. Ltd.—Length: top, 360'0"; bottom, 340'0". Breadth at Entrance: top, 60'0"; bottom, 40'0". Depth: 19'6". Dairen: South Manchuria Railway (Japanese Government). Leased by Kawasaki Dockyard Ltd. Length: top, 422'1"; bottom, 381'1". Breadth at Entrance: 42'11" on bottom. Depth: 19'9".

Foochow: Chinese Government.—Dry Dock.—Length: top, 328'0"; Breadth at Entrance: top 70'0". Depth: 20'0".

Hongkong: No. 1 Dock. Imperial Government. Length: top, 568'7"; bottom, 556'9". Breadth at Entrance: top, 95'0". Depth: 39'3".

Taku: Imperial Dock and Naval Yard. Length: top, 360'0"; bottom 335'0". Breadth at Entrance: 40'0". Depth: 12'0".

Taku: Dry Dock No. 1, Taku Tug & Lighter Co. Ltd.—Length: top, 335'0"; bottom, 315'0". Breadth at Entrance: 36'0". Depth: 11'0"

Taku: Dry Dock No. 2, Taku Tug & Lighter Co., Ltd.—Length: top, 300'0"; bottom, 275'0". Breadth at Entrance: 30'0". Depth: 10'0".

Taku: Dry Dock No. 3, Taku Tug & Lighter Co., Ltd.—Length: 300'0" on blocks. Breadth at Entrance: 28'0". Depth: 10'6".

Taku: Dry Dock No. 4, Taku Tug & Lighter Co., Ltd.—Length: 300'0" on blocks. Breadth at Entrance: 40'0". Depth: 10'6".

Tongku: Dry Dock No. 1, Etablissement Docks & Appontments de Tongku.—Length: 260'0". Breadth at Entrance: 50'0". Depth: 9'0".

Whampoa: Cooper's Dock: Chinese Government. Length: 430'0". Breadth at Entrance: 65'0". Depth: 16'0".

Whampoa: Locksun Dock: Chinese Government.—Length: 450'0". Breadth at Entrance: 75'0". Depth: 18'0".

## PHILIPPINE ISLANDS

Cebu: Patent Slipway: Manuel Novo.

Iloilo: Patent Slipway: Cho Hanlin.

Manila: (Cavite) Arsenal Slip: U. S. Government.

Manila: (Malabon) Patent Slipway: Luis R. Yangco.

Manila: Patent Slipway: Luis R. Yangco.

Manila: (City) Dry Dock: Length: 105'0". Breadth at Entrance: 24'0". Depth: 7'6".

Manila: Patent Slipway: Juan Rodriguez.

Manila: Patent Slipway: Insular Government.

## SIAM

Bangkok: Dry Dock No. 1: Bangkok Dock Co., Ltd.—Length: top, 300'0"; bottom, 260'0". Breadth at Entrance: top, 45'0"; bottom 40'0". Depth: 11'6"

Bangkok: Dry Dock No. 2: Bangkok Dock Co. Ltd.—Length: top, 110'0"; bottom, 100'0". Breadth at Entrance: 23'0". Depth: 7'6".

Bangkok: Dry Dock No. 2; Government.—Length: top, 321'7"; bottom, 302'5". Breadth at Entrance: 48'0". Depth: 14'6".

Bangkok: Dry Dock No. 2. Samsen Dock & Engineering Co. Ltd.—Length: top, 215'0"; bottom, 205'0". Breadth at Entrance: 33'0". Depth: 13'0".

Bangkok: Patent Slip: Howarth, Erskine, Ltd.

## SIBERIA

Vladivostok: Floating Dock: Government. Length: top, 301'0"; bottom, 301'0". Breadth at Entrance: 74'6". Depth: 26'0".

Vladivostok: Dry Dock: Government. Length: 572'0" top; 512'0" bottom. Breadth at Entrance: 90'0". Depth: 30'0".

Vladivostok: Dry Dock: Government. Length: top, 625'6"; bottom, 618'6". Breadth at Entrance: 90'0". Depth: 34'6".

## STRAITS SETTLEMENTS

Penang: Patent Slip: Eastern Shipping Co., Ltd.

Penang: Patent Slip: Eastern Shipping Co., Ltd.

Selangor: Patent Slipway: Government.

Singapore: Tanjong Rhoo Slipway No. 1. Singapore Slipway and Engineering Co., Ltd.

Singapore: Tanjong Rhoo Slipway No. 2. Singapore Slipway and Engineering Co., Ltd.

Singapore: Tanjong Rhoo Slipway No. 3. Singapore Slipway and Engineering Co., Ltd.

## SUMATRA

Belawan: Nil.

Deli: Nil.

Olehleh: Nil.

Padang: Nil.

## TONKIN

Haiphong: Patent Slip: Marty & d'Abbadie.

Saigon: Dry Dock: Government.—Length: 530'0". Breadth at Entrance: 72'0". Depth: 30'0".

Saigon: Small Dry Dock for Gunboats. Government. Length: 236'0". Breadth at Entrance: 32'5". Depth: 12'0".

Saigon: Floating Dock: Government. Length: 135'0". Saigon Three Slips, each.—Government.

## INDIES, EAST

Java: (Batavia) Floating Dock: Droogdok Maats. Tandjong Priok. Length: 324'0". Breadth at Entrance: 67'0".

Java (Batavia) Patent Slip: Droogdok Maats. Tandjong Priok.

Java: (Sourabaya) Iron Floating Dock: Government. Length: 328'1". Breadth at Entrance: 62'3". Depth: 24'6".

Java: (Sourabaya) Three Pontoons: Government.

Java: (Sourabaya) Patent Slip: Government.

## BIDS OPENED AT MANILA ON CONSTRUCTION OF INTER-ISLAND SEAGOING TRANSPORT.

Bids were opened at the Office of the Chief Quartermaster for the construction of an Inter-island sea-going transport as follows:

The Hongkong & Whampoa Dock Co., Ltd., of Hongkong, \$347,625 U. S. C.; Shanghai Dock & Engineering Co., Ltd., \$314,000 U. S. C., and the Taikoo Dockyard and Engineering Co., Ltd., of Hongkong, \$310,796 25, the last being the lowest bid. The first two bidders asked for 12 months to deliver and the Taikoo, 13 months.

The following are the specifications:

A twin screw transport steamer of the awning deck type, length over all 300 feet; length between perpendiculars 285 feet; beam 45 feet, and depth 28 feet. Power will be furnished by two sets of triple expansion, surface condensing steam engines, to have boilers approximately 12 feet in diameter and 12 feet long. These engines to be capable of developing power for a speed of 12½ knots.

## J. J. CHOLLOT

INGENIEUR DES PONTS ET CHAUSSEES

CIVIL ENGINEER, SURVEYOR AND ARCHITECT

53 QUAI DU YANG-KING-PANG, SHANGHAI



## A. J. MORSE &amp; SON, INC.

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ESTABLISHED 1837

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